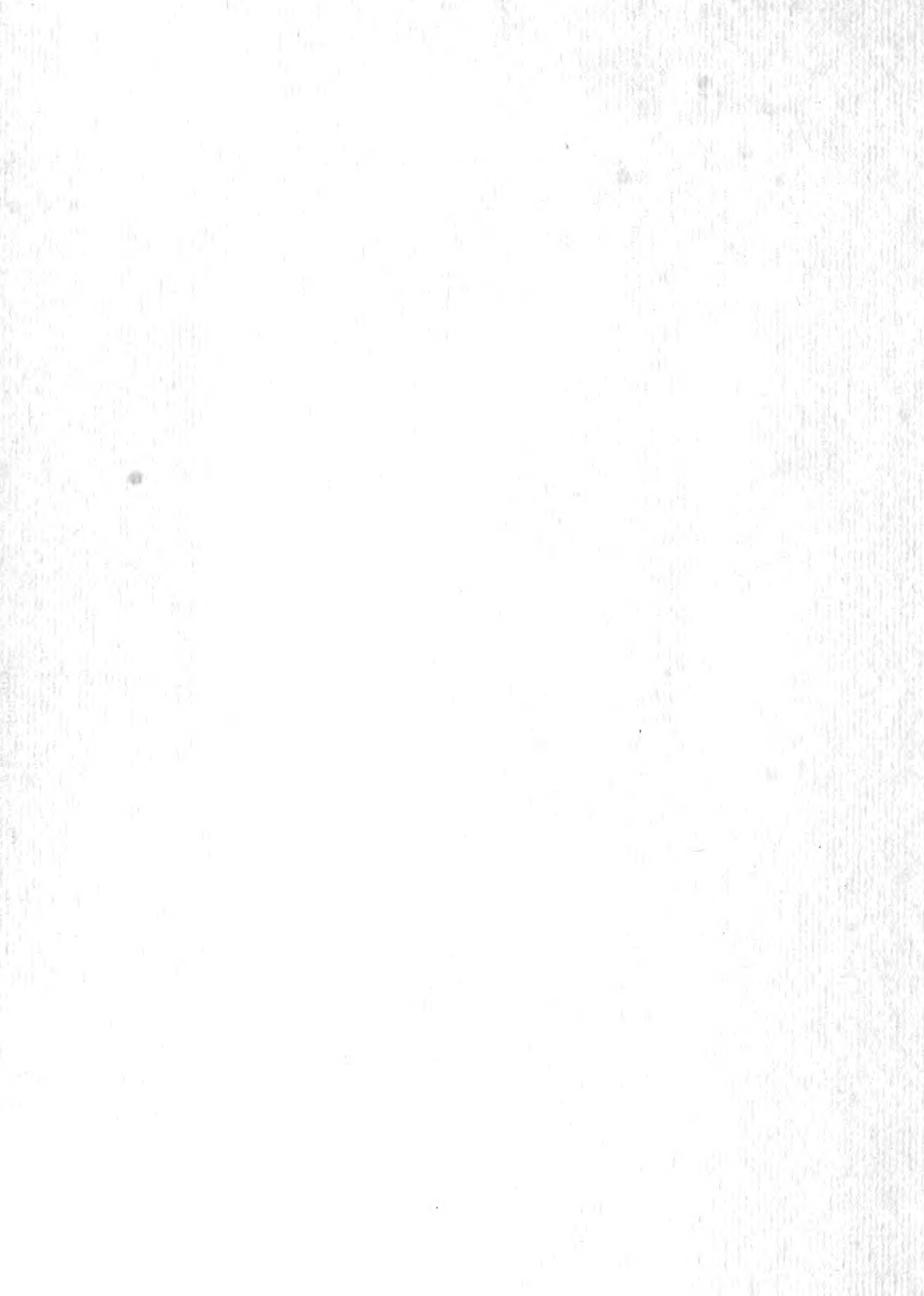


H. M. S. Challenger.





Thomas M. Schuch  
April, 1968







THE  
VOYAGE OF H.M.S. CHALLENGER.

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# C O N T E N T S.

I.—REPORT on the ALCYONARIA collected by H.M.S. CHALLENGER during the years 1873–1876.

By Professor E. PERCEVAL WRIGHT, M.D., &c., and Professor TH. STUDER, M.D.

*(The Manuscript was received in Instalments between 26th November 1885 and 21st December 1888.)*

II.—REPORT on the PELAGIC FISHES collected by H.M.S. CHALLENGER during the years 1873–1876.

By ALBERT GÜNTHER, M.A., M.D., Ph.D., F.R.S., Keeper of the Department of Zoology in the British Museum.

*(The Manuscript was received in Instalments between 27th November 1888 and 19th December 1888.)*

III.—SUPPLEMENTARY REPORT on the POLYZOA collected by H.M.S. CHALLENGER during the years 1873–1876.

By ARTHUR W. WATERS, F.L.S., F.G.S.

*(The Manuscript was received 18th October 1888.)*



## EDITORIAL NOTES.

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THIS Volume contains Parts LXIV., LXXVIII., and LXXIX. of the Zoological Series of Reports on the Scientific Results of the Expedition.

Part LXIV.—Professor v. Kolliker described the PENNATULACEA in the First Volume of the Zoological Reports (Part II.), but he was unable to undertake a description of the whole of the ALCYONARIA collections made during the Expedition.

Professor E. P. Wright, M.D., was consequently invited to undertake the examination and description of the Alcyonaria, other than the Pennatulacea. Professor Th. Studer was subsequently associated with Professor Wright in the preparation of this Report, which presents the result of their joint labours. It extends to 386 pages and 49 lithographic plates, together with woodcuts.

Part LXXVIII.—This Part deals with the PELAGIC FISHES, and is Dr. A. Günther's Third and concluding Report on the Fishes collected during the Expedition, the other Reports being Part VI. (Vol. I.), on the Shore Fishes, and Part LVII. (Vol. XXII.), on the Deep-Sea Fishes. The present Report consists of 47 pages and 6 plates.

Part LXXIX.—In this Report will be found some valuable Supplementary Notes on the Challenger POLYZOA, by Mr. A. W. Waters. The original Reports on the Polyzoa, by the late Mr. George Busk, form Parts XXX. and L. of the Zoological Series of Reports. This Supplementary Report consists of 41 pages and 3 plates.

JOHN MURRAY.

*CORRIGENDA.*  
*FOR PART LXIV.*

Page 24, "*Riisca*," see pages xlv and 278.

Page 40, line 4 from the bottom, for "*Mopsella*," read "*Mopsea*."

Page 93, line 14 from the bottom, for "fig. 30," read "page 30."

Page 118, line 9, for "*purpuracea*," read "*furfuracea*."

Page 124, line 7 from the bottom, for "*Muricella umbraticoides*, Studer," read "*Muricella umbraticoides* (Studer)."

Page 124, line 6 from the bottom, for "*Muricella*," read "*Muricea*."

Page 137, for lines 6 and 7, read "*Non Plexaura flexuosa*, Lamouroux, Valenciennes ("de la Havane"), Comptes rendus, t. 41, p. 12, 1855."

Page 144, line 7 from the bottom, "*ramosissima*," should be in roman type.

Page 162, line 4 from the bottom, for "*Suberia*," read "*Solenocaulon*."

*Pages 173–192 were printed off before Plates XL and XLI were drawn, and the following corrections are therefore necessary:—*

Page 173, for "fig. 5," read "figs. 4a, 4b."

Page 174, line 14, after "var. A." add "fig. 4a."

Page 174, line 16, after "var. B." add "fig. 4b."

Page 174, line 20, for "fig. 6," read "fig. 5."

Page 175, line 9, for "fig. 7," read "fig. 6."

Page 176, line 1, insert "Pl. XL. fig. 7."

Page 176, line 3 from the bottom, for "fig. 8," read "figs. 10, 10a, 10b."

Page 177, line 10 from the bottom, for "Pl. XL. fig. 9," read "Pl. XLI. fig. 1."

Page 178, line 18, for "Pl. XL. fig. 10," read "Pl. XLI. fig. 3."

Page 179, line 5, for "fig. 11," read "fig. 8," and line 32, for "fig. 12," read "fig. 9."

Page 180, line 27, for "fig. 1," read "fig. 2."

Page 182, line 13, for "fig. 2," read "fig. 4."

Page 183, line 23, for "fig. 3," read "fig. 5."

Page 184, line 14, for "fig. 4," read "fig. 6."

T H E  
VOYAGE OF H.M.S. CHALLENGER.  
...  
ZOOLOGY.

REPORT on the ALCYONARIA collected by H.M.S. Challenger during the  
Years 1873-76. By Professor E. PERCEVAL WRIGHT, M.A. Dub. and  
Oxon., M.D. Dub., Sec. R.I.A., &c., and Professor TH. STUDER, M.D.  
Bern, &c.

P R E F A C E.

IN July 1879, Sir C. Wyville Thomson invited Professor E. Perceval Wright to undertake the description of the Alcyonaria other than the Pennatulacea, which latter had been described by Professor v. K  lliker, and as, on inspection of the collection at Edinburgh, the number of species did not appear to be very extensive, the invitation was accepted, and the Alcyonaria were sent to Dublin in October 1879.

This collection was contained in sixty-nine bottles, and the sorting and provisional naming of the series was well advanced in the summers of 1880 and 1881, but it was not found possible to get the new species drawn until the spring of 1882, when Dr. Murray secured the services of Mr. George West, jun., by whom all the species figured, from the series referred to, have been drawn.

In 1882 a fresh collection of specimens of Alcyonaria was sent from Edinburgh; this collection, packed in six boxes, reached Dublin in July 1882. Five of these boxes contained tin cases, in which were found an immense assortment of forms which had been placed in strong spirits, just as they had been taken from the dredge. One box was filled with bottles and tubes containing numerous small species.

This second collection was found on examination to contain a number of new and rare species not found in the first series. Among others may be mentioned the remarkable

*Callozostron mirabilis*, *Calytrophora japonica*, and all the species of *Spongodes* hereafter mentioned, so that the work of description was more than duplicated. Mr. G. West was able to figure in 1882 some of the more remarkable species that were easily isolated from the mass; for the remainder, it required hours of careful patient labour to disentangle them the one from the other, before any attempt at description could be thought of. The complete assortment of the tangled series of forms preserved in these tin cases would have required a large amount of store bottles and space not always at disposal; it was not attempted and so it is possible that some few fragments of species in these tin cases may have escaped detection, but it is hoped that few if any have eluded the several searches made.

The work just alluded to occupied the summer of 1883, but all work on the collection had to cease (owing to a family affliction) during the year 1884 and the early part of 1885, when, with the sanction of Dr. Murray, Professor Th. Studer, M.D., of Bern, kindly consented to join Professor E. P. Wright in the completion of the Report. Antecedent to this event, the preliminary notice of the collection of Alcyonaria, published in the Narrative of the Voyage, had been printed, so that the species therein referred to had to bear by priority of publication the name of but one of the Reporters.

The work of description now proceeded quickly, but a great delay arose from the time and care necessary for the drawing and lithographing of not only the many new species in the second series of specimens, but also of the spicules of the whole of the forms described. This work was undertaken, under the supervision of Professor Studer, by Mr. Armbruster, of Bern.

In any joint work carried on by workers residing at so great a distance from one another as Dublin is from Bern, the difficulties of preserving uniformity of treatment must of necessity be great; and although one of us resided for a considerable time in the autumn of 1885 in Dublin, and the other has had several opportunities at Bern for consultation with his colleague, still we do not flatter ourselves that our Report will be mistaken for the symmetrical composition of a single author, but as it is our wish that we should together bear any credit for what may have been done well, so it is also our desire to bear in willing partnership the blame of any errors of commission or omission that may be detected in the following pages. The task of investigating the species already described was often an extremely difficult one, and it has seemed to us that there was no limit to the erroneous and imperfect accounts given by some writers on the group.

That we are in some measure satisfied with the accuracy of our determinations is in great measure due to the fact of our having visited the principal Museums of Europe, wherein collections of Alcyonaria were to be found. The Museums at Paris, Berlin, Erlangen, and Turin were visited by Professor E. P. Wright, with the permission of Dr. Murray, whilst at other times those of the British Museum, Bern, Zurich, &c., were also inspected.



It is our very pleasing duty to return our grateful thanks to Professor Perrier, of the Jardin des Plantes, Paris, for the great facilities he gave us for examining the most interesting collections under his care. Our best thanks are also due to Professor Selenka, of Erlangen, and to Professor Count Tommaso Salvadori, of Turin, for the opportunities they gave us of examining the original collections of Esper and of Duchassaing and Michelotti. We would also record our deep sense of the kindness shown us and the facilities given to us by the late Professor Peters, of Berlin. Alas the bestower of them is beyond our thanks.

We are indebted for much favour to the authorities of the British Museum, and in the investigation of the types of the late Dr. Gray, we have obtained immense help from the Rev. S. O. Ridley and Professor F. Jeffrey Bell, who from time to time forwarded to us measurements and descriptions of several feebly diagnosed forms.

To Professor v. K  lliker we would tender our very special thanks, he has on many occasions given us the great benefit of his extensive knowledge of the Alcyonaria, as well as supplied us with authentic specimens of important types.

To the following we have at times appealed for assistance and never in vain:—Professor L  tken, of Copenhagen; Dr. v. Martens, of Berlin; Dr. C. Keller, of Zurich; Professor A. C. Haddon, of the Royal College of Science, Dublin; and Professor Sollas, of Trinity College, Dublin.

To Dr. John Murray we owe a more than ordinary indebtedness; in all matters relating to the editing and illustrating of our Report he has at all times given us a ready and effective help. To Mr. W. E. Hoyle, and to Mr. James Chumley, of the Challenger Office, we are under great obligations for the painstaking and accurate revision of our proof sheets; a revision that was in the case of the former by no means confined to the ordinary task of correcting typographical errors, but embraced a supervision of the nomenclature and of the orderly sequence of the new species described.

It is a matter of regret to us, that we were unable to obtain specimens of the many important types of Alcyonaria described by Pourtal  s and Verrill, which were taken in the Three Cruises of the “Blake,” a detailed description of which is still anxiously awaited by those interested in this group.

Our thanks are due to Mr. George West, jun., and to Mr. Armbruster for the able execution of the work intrusted to them.

It only remains to mention that, in a Versuch eines Systemes der Alcyonaria, one of us published with the sanction of the Editor of the Challenger Reports, in the Archiv f  r Naturgeschichte for 1887, an account of several of the new genera found in the Challenger collection.

# TABLE OF CONTENTS.

	PAGE
PREFACE, . . . . .	i
INTRODUCTION, . . . . .	v
TABLE OF FAMILIES AND GENERA, . . . . .	lxix
DESCRIPTION OF GENERA AND SPECIES, . . . . .	1
GEOGRAPHICAL DISTRIBUTION, . . . . .	277
BATHYMETRICAL DISTRIBUTION, . . . . .	301
INDEX, . . . . .	305

## INTRODUCTION.

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In the *Histoire Naturelle des Coralliaires* of Milne-Edwards there will be found a succinct but accurate account of the various memoirs on the Alcyonaria which had been published prior to 1857, and as this work has lost none of its importance to the student of this group, we refer to its pages for a summary of the labours of the older writers. To Milne-Edwards, Dana, and Kölliker we are principally indebted for our knowledge of the classification and systematic position of the Alcyonaria, and but few attempts have been made to revise the systems under which these biologists arranged the forms known to them. Nevertheless during the last few years the number of new genera and species described has been very great, and at the same time very large additions have been made to our knowledge of the structure, growth, and development of many of the recent forms. While it does not seem necessary to give a complete bibliography of the group, such being already published in the various records of zoological literature, special reference must be made to the writings of Gray<sup>1</sup> and Verrill,<sup>2</sup> to the excellent monograph of Klunzinger<sup>3</sup> on the Corals of the Red Sea, and to the splendid memoirs of those of the North Sea by Koren and Danielssen,<sup>4</sup> nor must the writings of Marenzeller,<sup>5</sup> Marion,<sup>6</sup> and Ridley<sup>7</sup> be overlooked, as equally with the others advancing our knowledge of new species, while that of the minute structure of the group has been greatly furthered by the able researches of de Lacaze Duthiers,<sup>8</sup> Kölliker,<sup>9</sup> Moseley,<sup>10</sup> Kowalevsky and Marion,<sup>11</sup> Hickson,<sup>12</sup> Herdman,<sup>13</sup> Danielssen, von Koch,<sup>14</sup> and Pourtales.<sup>15</sup>

<sup>1</sup> J. E. Gray, *Catalogue of Lithophytes or Stony Corals in the Collection of the British Museum*, 1870, and very numerous papers in the *Proc. Zool. Soc. Lond.*, and the *Ann. and Mag. Nat. Hist.*

<sup>2</sup> The various Memoirs of Professor Verrill will be found quoted in full in the following Description of Genera.

<sup>3</sup> Dr. C. B. Klunzinger, *Die Korallthiere des Rothen Meeres*, Berlin, 1877.

<sup>4</sup> J. Koren and D. C. Danielssen, *Nye Alcyonider, Gorgonider og Pennatulider tilhørende Norges Fauna*, Bergen, 1883. D. C. Danielssen, *Den Norske Nordhavs-Expedition, 1876-78; Alcyonida*, Christiania, 1887.

<sup>5</sup> E. v. Marenzeller, in *Denkschr. math-nat. Cl. d. k. Akad. Wiss. Wien*, Bd. xxxv., 1877.

<sup>6</sup> A. F. Marion, *Comptes rendus*, t. xciv., 1882.

<sup>7</sup> S. O. Ridley, *Zool. Coll. of H.M.S. "Alert," 1884*, and papers in the *Proc. Zool. Soc. Lond.*, and in the *Ann. and Mag. Nat. Hist.*, 1881-1887.

<sup>8</sup> H. de Lacaze Duthiers, *Hist. Nat. des Corail*, Paris, 1863.

<sup>9</sup> A. Kölliker, *Icones Histiologicæ*, Leipzig, 1863, and numerous Memoirs as quoted hereafter.

<sup>10</sup> H. N. Moseley, *Phil. Trans.*, vol. clxvi., 1876; and *Zool. Chall. Exp.*, part vii., vol. ii., 1881.

<sup>11</sup> Alex. Kowalevsk and A. F. Marion, *Comptes rendus*, t. xciv., 1882; *Ann. Mus. d'hist. nat. de Marseille*, 1883.

<sup>12</sup> S. J. Hickson, *Phil. Trans.*, vol. clxxiv., and *Quart. Journ. Micr. Sci.*, 1883.

<sup>13</sup> W. A. Herdman, *Proc. Roy. Phys. Soc. Edin.*, vol. viii., 1884.

<sup>14</sup> G. v. Koch, *Morphol. Jahrb.*, vols. iv., v., vi., vii., and viii., 1878-1883; *Mitth. Zool. Stat. Neapel*, Bd. iii., 1882. *Die Gorgoniden des Golfes von Neapel*, &c., 1887.

<sup>15</sup> L. F. de Pourtales, *Bull. Mus. Comp. Zool.*, vols. v. and vi., 1878-1881.

(ZOOLOGICAL CHALLENGE.—PART LXIV.—1889.)

As regards the systematic arrangement of the class Verrill's<sup>1</sup> labours are to be specially noted. He has carefully distributed the numerous genera into well-defined and natural families, which he collects into the three suborders of Alcyonacea, Gorgonacea, and Pennatulacea. More recently von Koch<sup>2</sup> has published a classification of the Alcyonaria based on certain anatomical details, dividing them into nine families, by which he endeavours to show forth their natural affinities. Hickson<sup>3</sup> likewise with great ingenuity has based a system of classification on the presence or absence of a ciliated groove (siphonoglyphe) in the œsophagus of the polyps.

A natural classification of a group should no doubt be the record of its evolution, and should exhibit at a glance the stages through which the varied forms passed on their way to the attainment of their present positions. A very thorough knowledge of the life history of existing forms, and of the measure of their variableness, would be necessary ere the outlines of such a classification could be attempted, and for the filling in of the details one would require also a knowledge of extinct forms. Unfortunately for the perfection of such a scheme among the Alcyonaria there is no appeal to palæontology, the phenomena which are of most importance,—such as the structure and relations of the canal system, the structure and development of the individual polyp forms,—can never in fossil forms be known, owing to their being incapable of preservation in tables of stone.

We do not overlook the fact that in some cases the skeletal remains of forms such as those of the Favositidæ are to be met with, and that these, according to the convincing researches of Moseley, appear to be nearly related to the still living forms of the Helioporidæ, nor that the Syringopora are related to the Tubiporidæ, but these are but instances rather of extreme differentiation of type, branch endings that afford no clue to the peculiarities of the stem or root forms, presupposing generations of predecessors, whose nature will probably remain for ever unknown.

It follows therefore that there remains no other alternative but to trace out, as best can be done on the existing available material, the probable evolution of the types, but until much more is known as to the history of existing forms this cannot be done in an effective manner. Our first idea was to work out with this object in view the material collected by the Challenger, but it soon became apparent that some of it was not sufficiently well preserved for minute anatomical investigation, and that many important types living in shallow seas, as well as those from the Indian Ocean and the north-west coasts of America, were absent from this collection, so that we were forced to the conclusion that it would be premature to do more than present such an orderly arrangement of the group, as would for the present assist the student to a comprehension of the new forms described in our Report.

<sup>1</sup> A. E. Verrill, *Proc. Essex Inst.*, vol. iv. p. 145.

<sup>2</sup> G. v. Koch, *Mitth. Zool. Stat. Neapel*, Bd. iii. p. 537.

<sup>3</sup> S. J. Hickson, *Phil. Trans.*, vol. clxxiv. p. 693.

In all Alcyonaria, with the exception of the small family of the Haimeidæ, which may perhaps represent primitive forms, there is an all prevailing tendency to the production of colonies by a process of gemmation. The gemmæ do not arise directly from the body of the main polyp, but from stolons which originate as tubular processes from the alimentary cavities of the polyps. Following the varied growth of these stolons, the different colonial masses arise, either as narrow ribbon-like forms, or forming incrusting surfaces or bushy structures or tree-like stems. As the highest type of development, we may regard that type of colony in which a large number of individuals are so distributed, that each receives an equal share of the nutritive supply, a condition most perfectly realised on upright tree-like stems, where the branches and twigs bearing the individuals are arranged in spirals. But such a colony is additionally favoured when a supporting skeleton is differentiated so as to give the necessary support. The axis-forming Alcyonaria, for which the title Gorgonacea may be retained, exhibit in their higher forms just such a development, and reach it moreover in different ways, since the axis of the colony may be differentiated in various ways from the skeletal elements.

The simplest form of colony is that where the stem-polyps give off tubular processes, which represent sac-like diverticula of the body and contain a cavity which is continuous with the digestive canal of the polyp. On such stolons new polyps may arise by budding, and these may in their turn produce polyp-bearing stolons. Such colonies are to be found in the genera *Rhizoxenia* and *Cornularia*, and in some species of *Clavularia*. A more compact colony may arise, if the base of the polyps in which the mesoderm is greatly developed be broadened out so as to surround the polyps, and includes a series of endodermic tubes from which new polyps can arise by budding. Such expansions are known as the "cœnenchyma." They may give origin to flatly expanded crustaceous colonies like those of *Clavularia rosea*, Studer, and *Clavularia violacea*, Quoy and Gaimard. In these forms the cœnenchyma still remains as a thin membrane, on which the individual polyps are lodged, being only connected therewith by their bases; with a greater development of the cœnenchyma a larger portion of the polyp body becomes associated therewith, the deeper part of the elongated alimentary cavity being included in the cœnenchymatous expansion, as in *Anthelia*, *Sarcodictyon*, *Sympodium*, *Erythropodium*, *Callipodium*. Here the endodermic canals arise not only from the bases of the polyps, but also from their lateral walls, as far upwards as the cœnenchymatous thickening extends. The colony is, however, still crustaceous.

Such an arrangement can only be advantageous, however, under favourable nutritive conditions, where not alone the peripheral polyps but equally those in the centre of the colony share in the nutritive supply, or else in cases where the colony spreads over some irregular body, and thus brings the individual polyps into diverse relative positions, and in contact with different strata in the water. This will depend, however, on the nature of the foreign body which is so utilised.

The advantages of a diverse distribution of the polyps is gained in the higher forms by a different method. The colony, instead of growing over foreign bodies, becomes raised from an attached base, and expands freely. One surface of the colony gives origin to the individual polyps, while the other represents the attached surface of an encrusting form. From mechanical causes, however, the colony does not remain of a flattened shape, but becomes coiled up in a tube-like fashion, so as to bring the polyps to the outside, placing the former basal surface to the interior of the coil. At the same time spicules are differentiated in the cœnenchyma and become closely aggregated, so as to form a supporting axis. These conditions are seen in some of the lower forms belonging to the Briareidæ, such as *Solenocaulon*, while in the higher types the axis is better developed, occupies the interior of the colonial mass, and forms a cylinder, which is surrounded by the polyp-bearing cœnenchyma. In this way we may suppose that the division of Scleraxonia, of which *Corallium* represents the highest form, has developed.

In another series of forms, the favourable distribution of the individuals is otherwise attained. Bundles of polyps, the walls of which have thickened into a common cœnenchymatous mass, grow out into long cylindrical masses, and develop from their cœnenchyma new polyps at diverse heights. These may again form similar polyp bundles. In this way there arise those lobed masses as seen in *Alcyonium* and *Lobularia*, or if but a few tubes are united in each bundle, more bushy or tuft-like colonies as in *Nepthyidæ*.

Lastly, as another stage in the evolution, we find that a single polyp with a canalicular cœnenchyma grows out into a long cylindrical axial polyp, from the walls of which small polyps with short cavities and long tubular buds arise which may again bear small lateral polyps. Such a condition is exhibited by *Telesto* among the Cornulariidæ. For the development of a very expanded colony the hollow axial polyp forms by itself too weak a support, and there develops a more or less solid horny or calcareous central axis. The forms which thus arise fall into two divisions. The one (Pennatulacea) includes free, the other (Holaxonia or Axifera of v. Koch) more or less fixed colonies.

The advantages gained by the formation of an upward branching colony may, however, under special conditions become lost. This is seen in some of the axis-bearing Gorgonacea, when they occur at great depths. For here the food is not swept about by movements in the water, but falls from above to the bottom. It would be under these circumstances an advantage if the colony could be formed on the incrusting type, but since organic development progresses and cannot at once revert to an original type, the characters already established have to become adapted to the altered conditions, so we find that the Gorgonid stem in such instances becomes a creeping polyp-bearing axis and the polyps develop only on the one side, as in some species of *Strophogorgia*, *Bathygorgia*, and others. In this way all the polyps come to lie in the one plane, and each has an equal chance of obtaining the food as it falls from above.

And yet in another way may a support for the ascending colony be developed. In



the mesoderm of the body-wall of the polyp the skeletal elements may be greatly developed, so as to constitute the former a stiffened cylinder. The first beginning of such is to be seen in some species of *Telesto*, where the spicules of the body-wall so interlock as to produce a marked rigidity. Such a support is, however, well developed in *Tubipora*, where the spicules of the mesoderm coalesce with one another, so as to transform both the mesoderm of the polyps and of the stolons into solid tubes. In *Heliopora*, finally, we see crystalline calcareous masses appearing in the abundantly developed cœnenchyma, and the colony becomes a porous coral mass.

Another series of progressive modifications may be traced on the separate individuals of the various colonies, which have for their object the protection of the soft parts of the polyps, especially the oral region and the tentacles. These modifications are not unimportant as characterising the main divisions, and are of much use in determining the mutual relations of some of the families and genera. In the simplest cases, when the polyp contracts, its oral region is invaginated, and it folds the tentacles over the oral aperture. If the tentacles are on their abactinal surface furnished with spicules, they act in virtue of their position as a certain protection against external assault. Such conditions are exhibited by the species of several families and genera; thus among the Alcyonacea in Cornulariidae (*Rhizoxenia* and *Anthelia*); among the Scleraxonia in many Briareidae; among the Holaxonia in the Dasygorgidae. A progressive step in this adaptation of the tentacles for protective purposes is exhibited by many polyps, in which under the bases of their tentacles long spine-like spicules have developed. These surround the tentacles and oral region as a circle of sharp projecting spines, as in several species of *Spongodes*, *Ceratoisis*, and *Acanthogorgia*. If these spicules be broad triangular discs which may be laid down over the infolded tentacles, opercula are formed which close the entrance to the soft parts, as in the Primnoidae. At the same time the body-wall of the polyp always forms by means of embedded calcareous spicules a more or less rigid structure.

In Muriceidae the polyps exhibit a still more differentiated structure. In these each polyp consists of a basal portion thickly beset with spicules, which projects from the cœnenchyma of the calyx, then of an œsophageal region which is soft and without spicules, and lastly of an oral region including the oral disc and the tentacles, which at their bases are surrounded by a collaret of spicules. The bases of the tentacles are on their abactinal surfaces thickly beset with spicules. The entire œsophageal portion may be invaginated within the calyx, and over this the armed tentacles form an operculum. In its expanded condition the polyp is able to bend its body in diverse ways, since no spicules hinder the free mobility of its œsophageal portion.

A still greater freedom of motion is attained when the base of the polyp being rigid, the rest of the body remains soft and without, or with very few, spicules. The flaccid body can then be completely invaginated within the calyx, and closed by the

drawing together of its margins. The tentacles may be in these cases completely invaginated, as is seen in *Corallium* and *Heliopora*. Finally, the calyx may be feebly developed, and the whole polyp may withdraw itself into the coenenchyma which completely surrounds the lower portion of the alimentary cavity. When this happens over the entire colony the surface thereof appears smooth and as if covered with small pores.

A further differentiation of the individual polyps is seen in those cases where the colony consists of heteromorphic polyps, each with different functions. A certain amount of dimorphism is involved in the presence of connecting stolons, so that the tendency to polymorphism cannot be said to be absent even in the simplest forms. Some stolons end blindly and serve simply for the attachment of the colony. Somewhat similar vegetative individuals are represented by the axial polyps of the Pennatulacea and the Holaxonia. Besides the tentacle-bearing individuals or autozooids of Moseley, bud-like individuals may be present without tentacles and with a reduced number of mesenteric folds. These, the siphonozooids of Moseley, are found in very different families—in *Sarcophytum* and *Lobophytum* among the Alcyonidæ, in *Heliopora* among the Helioporidæ, in *Corallium* among the Scleraxonia, in *Dasygorgia* among the Holaxonia, and among the Pennatulacea.

If we attempt to establish a natural arrangement on the lines above indicated, we may first accept the three orders recognised by previous investigators, namely Alcyonacea,<sup>1</sup> Pennatulacea, Gorgonacea. We may further subdivide the Gorgonacea, or fixed Alcyonaria with colonial axial skeleton, into the two sections Scleraxonia and Holaxonia. The Alcyonacea may form the starting point for the two other suborders.

## ALCYONARIA, Milne-Edwards.

Polyps and polyp-colonies; the individual autozooids possess eight pinnate tentacles, and as many uncalcified mesenteric folds

### Order I. ALCYONACEA, Verrill.

*Alcyonacea*, Verrill, Proc. Essex Inst., vol. iv. p. 148.

*Alcyonidæ*, Milne-Edwards, 1857, Dana, 1859, Kölliker, 1865.

Polyps single or in colonies, when the latter, united by endodermic nutritive canals without axial skeletons.

<sup>1</sup> In the Description of Genera and Species the orders are arranged thus—Gorgonacea, Pennatulacea, Alcyonacea.

## Family I. HAIMEIDÆ.

*Haimeidæ* = *Haimeinæ*, Perc. Wright, Quart. Journ. Micr. Sci., vol. v. pp. 213–217, 1865.

*Haimeidæ*, v. Koch, Morphol. Jahrb., Bd. iv. p. 474.

*Monoxenidæ*, Haeckel, Arab. Korallen., p. 8, 1876.

In this family the polyps remain single, not uniting to form colonies; the polyp walls with or without spicules.

1. *Haimea*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 104; Koren and Danielssen, Nye Alcyonider, p. 15, Tab. 8.

The polyps are cylindrical, minute, retractile. There is no trace of stolons or of a spreading base. Spicules very thorny spindles, clubs and crosses. Nematocysts ovoid.

2. *Hartea*, Perceval Wright, Quart. Journ. Micr. Sci., vol. v. pp. 213–217, 1865.

Polyps elongated, retractile. Spicules spiny spindles.

3. *Monoxenia*, Haeckel, Arab. Korallen., p. 8.

The polyps without spicules.

## Family II. CORNULARIIDÆ.

*Cornulariadæ*, Dana, Zoophytes, p. 627; Kölliker, Icones histiologicæ, pt. ii. p. 131.

*Cornularinæ* and *Telestinæ*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 104.

*Cornularidæ*, Verrill, Proc. Essex Inst., vol. iv. p. 148.

*Cornularinæ*, Klunzinger, Korall. des rothen Meeres, i. p. 42.

*Cornularidæ*, v. Koch, Skelet d. Alcyonarien, Morph. Jahrb., Bd. iv. p. 474.

According to Klunzinger's diagnosis, the polyps are not united in bundles at the base to a stem or foot, but have cuticle-like or stolon-like expansions, or are branched and bear lateral buds.

The Cornulariidæ are a family of great interest, forming as it were a starting-point from which several families, or even orders, appear to diverge. *Rhizoxenia* may be regarded as one of the simplest colonial forms, allied to the simple polyp forms met with in Haimeidæ. From this *Anthelia* appears to diverge in one direction, where the polyps do not yet exhibit a stiffened calycine portion distinct from a retractile oral region, but have their bases surrounded by a thickened cœenchyma penetrated by large nutritive canals, and by a network of sap-canals. This development of a basal cœenchymatous membrane leads on to the conditions exhibited by the Xeniidæ.

In another direction, *Cornularia* seems to be a starting-point for *Clavularia* and *Sarcodictyon*. In *Clavularia* the polyps spring from stolon-like processes, or from a basal membrane. In this latter case the bases of the polyps are not surrounded by the membrane, but are seated upon its surface and continued into its substance by stolon-like endodermic tubes. Furthermore, in this genus the oral region is retractile within a rigid calyx portion. Similar conditions are, according to Herdman,<sup>1</sup> to be observed in *Sarcodictyon*, where the polyps, provided with retractile mouths, are seated upon a basal expansion. The latter is, however, narrow and stolon-like, and extends from each polyp mainly in two directions, so that the individuals of the colony are united in rows, and only at rare intervals are aggregated on a common basal surface. In *Cornularia* the polyps bear no spicules and the stolons have a horny ectodermic layer. In *Gymnosarca*, which is perhaps closely related to *Cornularia* through *Cornulariella*, the creeping stolons, which are numerous and thick-walled, anastomose and give off free cylindrical stolons on which polyps are seated. Finally, in *Telesto*, upright elongated polyps rise from the stolons, and exhibit thick, horny walls with spicules, from the canal-system of which there arise cylindrical individuals with shorter cavities. This genus also includes *Clavularia prolifera*, v. Koch, perhaps identical with *Gorgonia trichostemma*, Dana, and also *Clavularia rupicola*, described by F. Müller<sup>2</sup> under the generic title *Carijoa*. *Telesto* exhibits marked affinities with many Gorgonacea, towards which *Calogorgia* forms a transition link.

The genus *Cyathopodium* diverges in another direction. This is Verrill's generic title for *Aulopora tenuis*, Dan.,<sup>3</sup> in which the walls of the stolons become calcified, and thus suggest the condition met with in *Tubipora*. With *Clavularia*-like forms having flat basal expansions, certain genera are connected in which the tendency to upright branching appears. This is the case in the genus *Scleranthelia*, and in *Anthopodium*, which latter, according to Verrill, is related on the one hand to *Telesto*, on the other to *Callipodium*.

A group of forms, more or less related to *Sarcodictyon*, is formed by the genera *Sympodium*, *Erythropodium*, and *Callipodium*. Of these the latter, according to Verrill's description and figures, very closely resemble *Sarcodictyon*. On the other hand, the whole group is related to the family Briareidæ, which has perhaps been derived from similar forms.

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| 1. <i>Cornularia</i> , Lamarek.          | 5. <i>Anthelia</i> , Savigny.        |
| 2. <i>Rhizoxenia</i> , Ehrenberg.        | 6. <i>Gymnosarca</i> , Saville Kent. |
| 3. <i>Clavularia</i> , Quoy and Gaimard. | 7. <i>Cornulariella</i> , Verrill.   |
| 4. <i>Sarcodictyon</i> , Forbes.         | 8. <i>Telesto</i> , Lamouroux.       |

<sup>1</sup> *Proc. Roy. Phys. Soc. Edin.*, vol. viii. p. 31.

<sup>2</sup> *Archiv f. Naturgesch.*, Jahrg. xxxiii. p. 330, Anm. fig. 56, 1867.

<sup>3</sup> *Zoophytes*, p. 630, pl. lix. fig. 5.

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| 9. <i>Cælogorgia</i> , Milne-Edwards. | 13. <i>Sympodium</i> , Ehrenberg.    |
| 10. <i>Cyathopodium</i> , Verrill.    | 14. <i>Erythropodium</i> , Kölliker. |
| 11. <i>Scleranthelia</i> , Studer.    | 15. <i>Callipodium</i> , Verrill.    |
| 12. <i>Anthopodium</i> , Verrill.     | 16. <i>Pseudogorgia</i> , Kölliker.  |

1. *Cornularia*, Lamarck, Hist. Nat. Anim. sans Vertebres, t. ii. p. 3, 1816, ed. 2, p. 127; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 105.

The colony consists of a number of free polyps, united, however, to one another by root-like stolons, which latter creep over various foreign bodies. Spicules are not met with, but a horny substance gives some rigidity to the polyp tubes.

2. *Rhizoxenia*, Ehrenberg, Corallenth. d. rothen Meeres, p. 55, 1834; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 107; Dana, U.S. Explor. Exped. Zooph., p. 606.

*Evagora*, Phillipi, Archiv f. Naturgesch., Jahrg. viii. p. 36, 1842.

In this genus the colony resembles that of *Cornularia*, but the polyps are well furnished with spicules; the polyps are not retractile.

3. *Clavularia*, Quoy and Gaimard, cf. Blainville, Dict. d. Sci. Nat., t. x. p. 499, 1830; and Voyage de l'Astrolabe, t. iv. p. 260; Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 632.

The species of this genus resemble much those of *Cornularia*, but are easily distinguished from them by the presence of spicules, while the polyps being retractile can thus be separated from those of *Rhizoxenia*.

4. *Sarcodictyon*, Forbes, in Johnston's Hist. of Brit. Zooph., ed. 2, 1847, vol. i. p. 179; Herdman, Proc. Roy. Phys. Soc. Edin., vol. viii. p. 31.

The colony presents the appearance of a narrow band, the stolon, which is adherent and bears at intervals the retractile polyps. The stolon is flattened, tape-like, sometimes anastomosing; the polyps are mostly but not always in single series. The spicules are spiny spindles and irregular stellate and disc-like forms.

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5. *Anthelia*, Savigny, Lamarck, Hist. Nat. Anim. sans Vertebres, 1816, vol. ii. p. 407, ed. 2, p. 622; Kölliker, Icones histiologicæ, pt. ii. p. 132.

The colony consists of a membranous expansion upon which the non-retractile polyps are carried, their bases are surrounded by a somewhat thickened cœenchyma, which is penetrated by the nutritive canals. The polyp tentacles are retractile. The spicules of the cœenchyma and the polyps are spindles, sometimes spiny and warty, of a red colour or colourless.

6. *Gymnosarca*, Saville Kent, Quart. Journ. Micr. Sci., vol. xviii. p. 397, pl. xxi.

The colony contains numerous and thick-walled creeping stolons; these anastomose and give rise to free cylindrical stolons, on which the polyps are found. The polyps are cylindrical, semi-retractile. Spicules, fusiform and echinate spindles, mixed with some arcuate forms.

7. *Cornulariella*, Verrill, Amer. Journ. Sci. and Arts, 1874, ser. 3, vol. vii. p. 40 (footnote).

The colony consists of a series of creeping stolons, from which the tubular polyps arise. The polyps have large tentacles, with short thick pinnæ; the upper portion of each polyp has few spicules and is retractile within the lower portion, which is quite rigid from being well packed with numerous warty spindle-like spicules.

8. *Teleso*, Lamouroux, Bull. Soc. Philom. Paris, 1812; Polypiers flexibles, p. 232, 1816.

*Teleso*, *Telescella*, *Alexella*, Gray, Ann. and Mag. Nat. Hist., ser. 4, vol. iii. p. 21, 1869.

*Carijoa*, F. Müller, Archiv f. Naturgesch., Jahrg. xxxiii. p. 330, Anm., p. 56, 1867.

*Clavularia*, v. Koeh., Morph. Jahrb., Bd. vii. p. 468.

From a membranous base or from stolons the axial polyps with deep gastral cavities arise; from their body walls, lateral polyps bud forth; the polyp structure is in general like that in *Clavularia*. The walls of the polyp calyces, into which the anterior tentacular portion may be retracted, contain spicules. These are sometimes united together by a horny substance.

9. *Cælogorgia*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 191.

In this genus the colony is arborescent; the stem is formed by an axial polyp, which is attached by stolon-like processes; from its body wall branch-like axial polyps of a second order arise, which may again bear lateral polyps. The polyps are not retractile, the tentacles fold down over the oral portion. The whole colony and the polyps

are rigid and brittle, the spicules are straight or curved spindles which are often spiny and sometimes become almost club-like.

10. *Cyathopodium*, Verrill, Amer. Journ. Sci. and Arts, vol. xlv. p. 415, 1868.

*Aulopora*, Dana, Zooph., p. 630, pl. lix. fig. 5.

The colony reminds one of that of *Tubipora*; it consists of a series of short cup-shaped tubes, connected by narrow, calcareous stolons, which seem to correspond to the transverse plates in *Tubipora*, and from which the new polyps arise.

11. *Scleranthelia*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 624, pl. i. fig. 4.

The colony forms an irregular incrusting base, from which the polyps arise. The new polyps originate by budding from the base of the older polyps, so that sometimes there is an appearance of a small axis. The tentacles are retractile. The body wall of the polyps is furnished with a pavement of broad, polygonal, calcareous, scale-like spicules, which are warty on their outer sides.

12. *Anthopodium*, Verrill, Amer. Journ. Sci. and Arts, ser. 3, vol. iii. p. 434, 1872.

The colony is incrusting, firm. The polyps are large, prominent, retractile within tubular verrucæ. The surface of the cœnenchyma and verrucæ is minutely granular with the dentations of the spicules projecting; these spicules are irregular in outline, and closely united together. The spicules, in addition to those mentioned, are spiny spindles and clubs.

13. *Sympodium*, Ehrenberg, Corall. des rothen Meeres, p. 61; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 110; Köl liker, Icones histiologicæ, pt. ii. p. 141; Klunzinger, Korall. des rothen Meeres, pt. i. p. 42; Danielssen, Norske. Nordhavs-Exped., 1876-78, Zool. Alcyonida, p. 141.

The basis of the colony is a thin but leathery membrane, from which the pretty numerous polyps arise; these are short, retractile, and are sunk deeply into the basal membrane. The spicules are very small and disc-like.

14. *Erythropodium*, Köl liker, Icones histiologicæ, pt. ii. p. 141.

The colony has an incrusting and membranous base; with the polyps retractile within very small verrucæ, the retracted tentacles forming, on contraction, a stellate marking. The spicules are long, hexradiate, with rounded ends and small dentations.

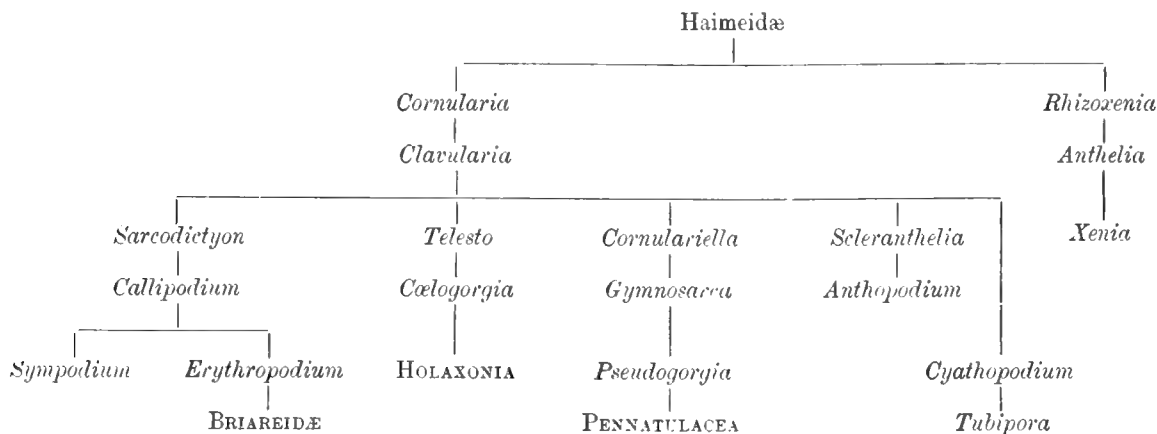
15. *Callipodium*, Verrill, Trans. Connect. Acad., vol. i., 1868, pt. 2, No. 6, p. 455.

The colony has a firm, more or less thickened cœnenchyma, either broadly expanded or in narrow stolons. Polyps rather large, with rounded verrucæ sometimes scattered, sometimes crowded; wholly retractile, in contraction forming an eight-rayed figure. Spicules irregular, some short spindles, others double clubs and crosses.

16. *Pseudogorgia*, Kölliker, Verh. d. phys.-med. Ges. Würzburg, N. F., Bd. ii. Heft. i. p. 12.

The colony in this very remarkable form is upright; nearly one-half of the main axis is destitute of polyps, while on the upper portion these are arranged in two rows on either side of the stem, which is flattened about its centre and becomes cylindrical towards the summit. The polyps are completely retractile within the cœnenchyma, leaving but slight verrucæ. The main axis itself is formed by an axial polyp, around the sides of which the lateral polyps have budded. The spicules are broad warty spindles.

The natural relationships of some of these forms may be indicated in the following scheme, without, however, claiming for it any great value from a phylogenetic point of view.



### Family III. TUBIPORIDÆ.

*Tubiporidæ*, Verrill, Proc. Essex. Inst., vol. iv., 1865, p. 148

*Tubiporina*, Ehrenberg, Corall. des rothen Meeres, p. 55.

*Tubiporinæ*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 130.

*Tubiporida*, v. Koch, Morph. Jahrb., pp. 474, 475.

The colonies form series of completely calcified coral stocks, consisting of numerous, approximately parallel, calcareous tubes; these tubes arise from the coalescence of the

spicules of the mesoderm. At short intervals the tubes are united by calcified transverse lamellæ formed from the stolons in which the polyps originate. The anterior portion of the polyps is retractile.

*Tubipora*, Linné, Syst. Nat. ed. 10, t. i. p. 789; Lamarck, Hist. Nat. Anim. sans Vert., t. ii. p. 207, and ed. 2, p. 324; Lamouroux, Expos. meth. des Polyp, p. 66; Blainville, Manual d'Actinologie, p. 500; Ehrenberg, Corall. des rothen Meeres, p. 55; Perc. Wright, Ann. and Mag. Nat. Hist., 1869, ser. 3, pp. 377-383; G. v. Koch, Anatomie d. Orgelkoralle, Jena, 1874; Klunzinger, Korall. des rothen Meeres, 1877, pt. i. p. 46; Sidney F. Hickson, Quart. Journ. Micr. Sci., 1883, xcii. pp. 516-528.

#### Family IV. XENIIDÆ.

*Xenidæ*, Verrill, Proc. Essex Inst., vol. iv. No. 5, 1865, p. 148.

*Xenidæ*, Gray (*pars*), Ann. and Mag. Nat. Hist., 1859, ser. 3, vol. iv. p. 443.

The colony consists of masses of long cylindrical polyps, which bear terminal crowns of non-retractile tentacles. The polyps are in their lower portion united by cœenenchyma in which are the ramifications of the canalicular system uniting the individual polyps. This cœenenchyma sometimes forms a branching axis, from the upper surface of which the free portions of the polyps project. The spicules are feebly calcareous disks.

*Xenia*, Savigny, Lamarck, Hist. Nat. Anim. sans Vert., t. ii. p. 409, 1816, ed. 2, p. 625; Lamouroux, Expos. method. d. polyp, p. 69; Klunzinger, Korall. des rothen Meeres, pt. i. 1877, p. 39.

*Heteroxenia*, Kölliker, Festschr. d. 25 Jahrg. phys.-med. Ges. Würzburg, 1875, p. 12.

*Cornularia* (*pars*), Quoy and Gaimard, Voy. Astrolabe, t. iv. p. 265, Zooph., pl. 22, fig. 1.

*Cespitularia*. Valenciennes, in Paris Museum.

*Xenia* seems closely allied to *Anthelia*, exhibiting in the prolongation of the polyp-tubes, and in the marked development of the cœenenchyma an advance in the colonial system. Heteromorphic forms were first observed by Kölliker in a new species, for which he instituted the genus *Heteroxenia*.

Klunzinger finds bud-like polyps in *Xenia umbellata* and *Xenia fuscescens*, Ehrbg.; in the former species, where they appear sparingly or are wanting, he leaves it an open question whether they are zooids or buds; in the last species he inclines to the opinion that they are zooids which do not develop beyond the bud-like stage. In a paper by W. Haacke (Zur Physiologie der Anthozoen, *Zool. Gart.* xxvii.), the author maintains, on the strength of his observation of the living animals, that the supposed zooids are buds which develop later into polyps. These observations, which appear to us trustworthy,

suggest the provisional abandonment of Kölliker's genus. *Wardella* has been established by Gray for *Xenia indivisa*, Sars. The statement that it exhibits an internal axis formed of spicules precludes its being placed in the family Xeniidæ.

#### Family V. ORGANIDÆ.

*Organinæ*, Danielssen, Norske Nordhavs-Exped. 1876-78, Zool. Alcyonida, p. 130.

*Organidus*, Danielssen, *loc. cit.*, p. 137.

In this genus the colony is deficient in cœnenchyma; the individual polyps are elongated and united together so as to form a short upright stem.

The polyps are long, cylindrical, soft; the collected polyps are attached by a slightly widened base. The polyps are retractile; both polyp body and tentacles are well furnished with spicules. The sexes are separate.

#### Family VI. ALCYONIDÆ.

*Alcyonidæ*, Verrill, *ex parte*, Proc. Essex Inst., vol. iv. No. v., 1865, p. 148.

*Alcyonidæ* + *Sarcophytidæ* + *Bellonelladæ* + *Nidaliidæ*, Gray, Ann. and Mag. Nat. Hist., ser. 4, vol. iii. pp. 123-127.

Polyp-stock fleshy, sometimes simple, sometimes irregularly branching, the basal portion, which forms a stem, generally without polyps. A thick cœnenchyma surrounds the long polyp tubes up to the retractile œsophageal portion. The digestive cavities of the polyps communicate with each other by a system of large and small nutritive canals. In some genera there is a dimorphism (siphonozooids and autozooids).

The Alcyonidæ exhibit a higher degree of colonial formation than the Xeniidæ. The polyp tubes are very long, and are united in strands which may even form a basal axis more or less rapidly broadened out so as to form a series of lobes or twigs on the terminal portions of which the polyps are found. A cœnenchyma always surrounds the polyp-tubes up to the œsophageal region, and into this portion the rest of the polyp may be retracted. The cœnenchyma is studded with spicules which may acquire a special form and abundance in the stem region. The polyp tubes are connected by a system of endodermic processes, which have their origin in the tubes and give rise to fresh polyps.

The species of *Bellonella* seem related to *Nidalia*. The polyp tubes, which are surrounded by a cœnenchyma with large spicules, end in projecting calyces, within which the tentacular portion may be retracted. *Bellonella* and *Cereopsis* are also nearly related, if they are not, as we think, to be united in a single genus. *Cereopsis bocagei*, Kent, seems synonymous with *Nidalia atlantica*, Studer and *Iphethyrus speciosus*, W. Koch.

In *Paralcyonium* the polyp colony consists of a stem portion with more or less firm walls, and a softer head-like portion giving off small twigs, from which the polyp mouths are seen projecting. The softer portion can be retracted along with the polyps into the firmer substance of the stem. The hardening of the stem portion and the feeble branching of the polyp-bearing portions bring this genus close to *Bellonella* or *Nidalia*.

In *Alcyonium* the whole colony forms an upright lobed mass, on which a short stem portion may be distinguished. *Lobularia* can hardly be separated from *Alcyonium*, and Klunzinger has included it in the same genus. Yet one may with Ehrenberg distinguish as *Lobularia* forms those Alcyonids in which the short broad stem is furnished with a number of lobes and lappets, and in which the cœnenchyma is very thickly beset with short calcareous spicules, especially double-clubs, ordinary clubs and spindles, so that it acquires quite a thick leathery consistence.

In *Sarcophytum* we find folded or lobed polyp stocks, with dimorphic polyps (autozooids and siphonozooids). Marenzeller divides Lesson's genus into *Sarcophytum*, with mushroom-like colonies, and *Lobophytum*, with the upper surface not mushroom-like, but with thick and elongated lappets, or finger-shaped processes.

In *Anthomastus* the colony forms a roundish mass, which is seated on a short, thick, sterile stem; a few very large polyps are completely retractile into eight-rayed calyces; numerous small siphonozooids occur scattered between the polyps; the cœnenchyma is abundant, firm, and provided with fine spicules. It seems probable that *Sarcophytum purpureum*, Koren and Danielssen, should be referred to this genus.

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| 1. <i>Crystallophanes</i> , Danielssen. | 7. <i>Lobularia</i> , Savigny.                       |
| 2. <i>Bellonella</i> , Gray.            | 8. <i>Sarcophytum</i> , Lesson, <i>emend.</i> Maren- |
| 3. <i>Nidalia</i> , Gray.               | zeller.  |
| 4. <i>Paralcyonium</i> , Milne-Edwards. | 9. <i>Lobophytum</i> , Marenzeller.                  |
| 5. <i>Sarakka</i> , Danielssen.         | 10. <i>Anthomastus</i> , Verrill.                    |
| 6. <i>Alcyonium</i> , Linneus.          | 11. <i>Nannodendron</i> , Danielssen.                |

1. *Crystallophanes*, Danielssen, Norske Nordhavs-Exped., 1876-1878; Zool. Alcyonida, 1887, p. 129.

The colony has a soft stem which is dilated at the base and adherent to dead shells, the branches are short, thick, broad at their origin and somewhat dilated at their extremities, where they bear six to eight polyps. The branches are short and in spires leaving bare intervals; cœnenchyma dense. Polyps retractile.

2. *Bellonella*, Gray, Proc. Zool. Soc. Lond., 1862, p. 35.

*Iphethyrus*, W. Koch, Neue Anthozoen, Marburg, 1886, p. 3.

*Nidalia*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 633.

*Cereopsis*, Saville Kent, Quart. Journ. Micr. Sci., vol. xviii., 1876, pp. 397-399.

The colony is erect, unbranched, attached by a somewhat expanded basal portion; the lower part of the stem is destitute of polyps, the upper portion is slightly lobate, bearing scattered, semi- or completely retractile polyps. The spicules fusiform, echinate. Perhaps identical with the following genus.

3. *Nidalia*, Gray, Proc. Zool. Soc. Lond., 1835, p. 60.

The colony is simple or branched, axis cylindrical, tough, with numerous spicules. Polyps large, prominent, collected on the upper surface of a hemispherical head. The spicules are described as "large conical."

4. *Paralcyonium*, Milne-Edwards, Ann. des Sci. Nat., sér. 2, t. iv. p. 323, 1835.

The colony presents two distinct portions, one, the basal portion, is dense, with firm walls; the other, the head, alone bears the polyps, and can be in part withdrawn into the basal part. The polyp bearing portion is but feebly lobed.

5. *Sarakka*, Danielssen, Norske Nordhavs-Exped. 1876-78, Zool. Alcyonida, 1887, p. 118.

The colony is but little branched, the main axis and the branches are crowned with numerous retractile polyps, with marked calyces, ribbed; the polyps are short and tightly packed together so as to leave little coenenchyma. The whole colony is rich with spindle-shaped and stellate spicules.

6. *Alcyonium*, Linné, Syst. Nat., ed. 10, t. i. p. 803, 1758; Pallas (*pars*), Elench. Zooph., p. 242, 1766; *non Halcyonium*, Ehrenb., Corall. des rothen Meeres, p. 56; Milne-Edwards (*pars*), Hist. Nat. des Coralliaires, t. i. p. 114; Klunzinger, Korall. des rothen Meeres, pt. i. p. 21.

The colony presents the appearance of variously lobed, soft masses, over the surfaces of which the polyps are spread. The polyps are completely retractile. The spicules are



chiefly spindles which are not very densely distributed in the cœnenchyma. There is some difficulty in distinguishing this genus from the following.

7. *Lobularia*, Savigny, Lamarek, Hist. Nat. Anim. sans Vert., t. ii. p. 412, 1816; Ehrenb., Corall. des rothen Meeres, p. 57.

The colony like that of the previous genus, but the short, broad stem is furnished with a series of lobes or lappets, the cœnenchyma of which is thickly packed with spicules; these are spindles, clubs and double clubs.

8. *Sarcophyton*, Lesson (*pars*), Voyage de Béllanger aux Indes orientales, and Zool. du Voyage de la Coquille, Zooph., p. 92, 1831; *Sarcophytum*, *emend.* Marenzeller, Zool. Jahrb., Bd. i. p. 351.

*Halcyonium*, Ehrenb., Corall. des rothen Meeres, p. 56.

The colony is mushroom-shaped; the stem barren, the upper expanse of the colony bearing the polyps, which are dimorphic, and completely retractile. The spicules of the barren stem, polyp bearing portion and polyps are characteristic, being warty spindles, cylinders and club-shaped.

9. *Lobophytum*, Marenzeller, Zool. Jahrb., Bd. i. p. 352.

The colony is not mushroom-shaped. The polyps are dimorphic, occurring only on the lobes of the colony, the base being sterile. The spicules are echinulate spindles and small clubs, with some cylindrical forms with zones of warts.

10. *Anthomastus*, Verrill, Amer. Journ. Sci. and Arts, vol. xvi. p. 376, 1878.

The colony forms a rounded mass, with a short barren peduncle, which is either directly adherent or is fixed in the mud by root-like peduncles. Polyps dimorphic, the autozooids large, few in number. Spicules spiny and branching spindles.

11. *Nannodendron*, Danielssen, Norske Nordhavs-Exped. 1876-1878; Zool. Alcyonida, 1887, p. 74.

The colony is arborescent. The axis is hard and grooved; basal part discoid, coriaceous. The branches arise from base to summit; they are hard, lobate, fitting compactly to one another; they are richly furnished with polyps; these are retractile cylindrical; in addition, siphonozooids are very numerous.

## Family VII. NEPHTHYIDÆ.

*Nepthyidæ*, Verrill, Proc. Essex Inst., vol. vi., 1869, p. 46.

*Siphonogorgiaceæ*, Kölliker, Festschr. phys.-med. Ges. Würzburg, 1874, p. 22.

*Spoggodinæ*, Dana, U.S. Explor. Exped., Synopsis of Report of Zoophytes, p. 126.

*Spoggodidæ*, *Nephtyadæ*, and *Lemnaliadæ* (*pars*), Gray, Ann. and Mag. Nat. Hist., ser. 4, vol. iii. pp. 128-130.

*Alcyoniens armés*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 127 (*pars*).

*Alcyoninæ capituliferæ* and *Siphonogorgiaceæ*, Klunzinger, Korall. des rothen Meeres, pt. i., 1877, pp. 30, 48.

In this family the polyps form upright branched colonies, which consist of a more or less elevated sterile trunk, and of branches ramifying in the most varied fashion and bearing terminal polyps. The latter do not exhibit separate calyx and tentacle bearing regions, so that there can be no complete invagination of the upper tentacle-bearing polyp portion into the lower gastral region. The tentacles when at rest are simply folded over the oral disc. The polyp bodies are continued into long gastral cavities, which do not, for the most part, directly communicate with one another, but are separated by thin walls. Each gastral cavity narrows below, and terminates in a *cul de sac*. A few, however, are occasionally continued directly into the canals of the stem. The main axis and the larger branches are penetrated by wide canals, which are only separated from one another by thin partitions, sometimes with, sometimes without, spicules. A thicker external sheath, furnished with spicules, surrounds the stems externally, and the large canals are connected with the elongated polyps by tubes which take their origin from the bottom of the polyps. In the walls which separate the polyps there is a system of small capillary sap-canals. From these the young buds arise between the older polyps; these have longer or shorter digestive cavities according to their age. In the branches four wide canals may be usually distinguished, the walls of which come into contact in the axis of the branch. Fresh polyps, the small tubes of which are visible on cross sections, arise externally from these four principal canals in the interspaces between the pairs. Their partition walls do not, however, extend to the axis. Towards the end of the branch or of the twigs the new buds with their smaller digestive cavities become more abundant. The *Nepthyidæ* appear to have had their origin from among the lower *Alcyonids*, such as *Bellonella*, which exhibit analogous relations in their polyps.

The family may be divided into two subfamilies:—(a) those in which the walls between the stem-canals include very few or no spicules—the *Spoggodinæ*; and (b) those in which spicules are abundantly present in the walls of the canals—the *Siphonogorginæ*.

## 1. SPONGODINÆ.

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|--------------------------------------|---|
| 1. <i>Væringia</i> , Danielssen.     | 7. <i>Duva</i> , Koren and Danielssen.                |
| 2. <i>Fulla</i> , Danielssen.        | 8. <i>Eunephthya</i> , Verrill.                       |
| 3. <i>Barathrobius</i> , Danielssen. | 9. <i>Ammothoa</i> , Savigny.                         |
| 4. <i>Gersemia</i> , Marenzeller.    | 10. <i>Nephthya</i> , Savigny.                        |
| 5. <i>Gersemiopsis</i> , Danielssen. | 11. <i>Spongodes</i> , Lesson, <i>emend.</i> Verrill. |
| 6. <i>Drifa</i> , Danielssen.        |   |

## 2. SIPHONOGORGINÆ.

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|--|---|
| 12. <i>Paranephthya</i> , Wright and Studer.   | 14. <i>Chironephthya</i> , Wright and Studer. |
| 13. <i>Scleronephthya</i> , Wright and Studer. | 15. <i>Siphonogorgia</i> , Kölliker.          |

## Subfamily 1. SPONGODINÆ.

1. *Væringia*, Danielssen, Norske Nordhavs-Exped., 1876-78, Zool. Alcyonida, 1887, p. 8.

Colony arborescent ; branches arranged around the stem and thick, branchlets crowded ; the stem leathery, basal portion membranous ; longitudinal canals wide, strongly marked. Polyps numerous on branchlets, retractile. Spicules very numerous on stem, branches, and on the polyp body and tentacles.

2. *Fulla*, Danielssen, *loc. cit.*, p. 80.

Colony arborescent ; the stem is somewhat flattened, with a distinct bilateral symmetry, branches from the sides of the main stem. Polyps arising partly singly and partly in groups from the sides of the branches ; retractile and elongate. Spicules of the stem bistellate, those of the polyps also fusiform.

3. *Barathrobius*, Danielssen, *loc. cit.*, p. 109.

The colony is either arborescent or shrub-like ; the branches either simple or again branching. The polyps are cylindrical, retractile within a calyx portion. The stem and branches well furnished with stellate and clavate spicules. The spicules of the polyp calyx are placed transversely, those on the anterior portion in longitudinal bundles, which pass into the tentacles.

4. *Gersemia*, Marenzeller, Denkschr. math.-nat. Cl. d. k. Akad. Wiss. Wien, Bd. xxxv. 1877, p. 18 (Reprint).

The colony consists of an upright stem with only a few simple branches, which bear tufts of polyps, with non-retractile tentacular regions. Only the body-wall of the polyps, the tentacles, and the cortical layers of the stem are furnished with spicules. The individual polyp-tubes appear to be indirectly continued into the large sap-canals.

5. *Gersemiopsis*, Danielssen, Norske Nordhavs-Exped., Zool. Alcyonida, p. 103.

The colony is branched, the branches again ramifying. The cœnenchyma is feebly developed; canals wide. The polyps are long, cylindrical, and non-retractile. The œsophagus is furnished with two flap-like protuberances. The spicules are chiefly clavates and subclavates.

6. *Drifa*, Danielssen, *loc. cit.*, p. 64.

The colony is arborescent; the main branches are thick and from them proceed numerous branchlets, bearing the polyps. The polyps are closely set, elongate, non-retractile, with well-developed calyces. The spicules, chiefly subclavate forms, are very numerous in the stem, branches, and polyps.

7. *Duva*, Koren and Danielssen, Bergens Museum, Nye Alcyonider, 1883, p. 1; Danielssen, Norske Nordhavs-Exped., 1876-78, Zool. Alcyonida, 1887, p. 37.  
*Gersemia (pars)*, Marenzeller, *loc. cit.*, p. 18.

The colony is upright and branched; the terminal twigs bear tufts of polyps which are not retractile, and are furnished with long, spindle-shaped spiny spicules. The branches and twigs contain no spicules. In the cortex of the stem, short many-rayed spindles and double stars are to be found.

8. *Eunephthya*, Verrill, Amer. Journ. Sci. and Arts, vol. xlvii. p. 284, 1869; Proc. Essex Inst., vol. vi. p. 81, 1869.  
*Nephthya*, Savigny (*pars*), Polyp. Egypt.; Danielssen, *loc. cit.*, p. 87.  
*Ammonothea*, Marenzeller, *loc. cit.*, p. 16.

The colony forms an upright stem from which accessory branches are given off on all sides. These may again branch, or give origin directly to tufts of polyps. The latter are large, non-retractile, and covered with thorny club-shaped or branched spicules, the ends of which project beyond the surface. These occur only in the cortex of the stem, not on the walls of the canals.

9. *Ammonothea*, Savigny, Polyp. Egypte, t. ii. fig. 6 ; Lamarck, Hist. Nat. Anim. sans Vert., t. ii. p. 410, ed. 2, p. 628 ; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 123 ; Klunzinger, Korall. des rothen Meeres, pt. i. p. 30.

The upright colony is branched like a tree, or gives off a number of uniform, cylindrical, finger-like branches from a flat base. The branches bear polyps which are not retractile, and like the stem and branches are beset by small spiny clubs and spindles. As the points of the spicules do not project beyond the surface the latter appears smooth. Danielssen (Alcyonida, 1887, p. 81) points out the fact that Leech used the name *Ammonothea*, in 1814, for a Crustacean, which Lamarck overlooked when in 1816 he used it for an Alcyonarian. Danielssen further suggests that as the two genera *Ammonothea* and *Nephthya*, Savigny, can scarcely be retained as distinct, the latter name should be adopted for the group.

10. *Nephthya*, Savigny, Atlas du grand ouvrage sur l'Egypte, Hist. Nat., t. ii. pl. ii. ; Ehrenberg, Korall. des rothen Meeres, p. 60 ; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 127 ; Klunzinger, Korall. des rothen Meeres, pt. i. p. 33.

A genus very like the last, but with the heads of the polyps beset with tolerably large and long calcareous spindles. These are closely apposed, and give the head a rigid consistence. Both stem and branches are firm and leathery owing to the calcareous spicules in the cortex.

11. *Spoggodes*, Lesson, Illustrations de Zoologie, 1834. *Spongodes*, Verrill. *emend.*

*Spoggodia*, Dana, Zoophytes, p. 625.

*Spoggodes*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 128.

*Spongodes*, Verrill, Proc. Essex Inst., vol. vi. p. 45, 1869.

*Spoggodes*, *Spoggodia*, Gray, Proc. Zool. Soc. Lond., 1862, p. 27.

*Morchellana*, Gray, Proc. Zool. Soc. Lond., 1862, p. 30.

*Spongodes*, Klunzinger, Korall. des rothen Meeres, pt. i. p. 34, 1877.

*Spongodes*, Ridley, Rep. Zool. Coll. H.M.S. "Alert," p. 333.

The form of the colony varies greatly according to the extent of the sterile trunk. The polyps are non-retractile. Their heads, which contain large spicules and have a firm consistence, are over-arched by tufts of large spindle-shaped spicules projecting as spines beyond the polyps. The internal septa are not furnished with spicules, while the cortex of the stem and of the branches contains large spicules, giving to these a firm consistence.

## Subfamily SIPHONOGORGINÆ.

*Siphonogorgiacea*, Kölliker, Festschr. phys.-med. Ges. Würzburg, 1874, p. 22; Klunzinger, Korall. des rothen Meeres, pt. i., 1877, p. 48.

12. *Paranephthya*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. 1, p. 20.

The whole colony is upright and branched, and consists of a stem and branches. The latter are again branched, and their terminal portions are covered over with the polyp-heads, of which the tentacular portions are non-retractile. The canals of the stock are narrow, numerous, and separated by partition-walls of relative thickness. There are small foliaceous clubs in the polyps, in the cortical portions of the stem, and in the walls of the canals.

13. *Scleronephthya*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. 1, p. 20.

The form of the colony and the nature of the canalicular system resemble the above, but simple polyp-heads frequently occur scattered over the stem and branches. The calyces are furnished with large spindle-shaped spicules, which also occur in the cortex.

14. *Chironephthya*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. 1, p. 20.

The simple stem, which remains of uniform thickness throughout its course, gives off terminally simple finger-shaped rigid branches. These bear isolated polyps at some distance from one another, and but rarely give off secondary branches. Polyps and stem are covered with large spindle-shaped spicules. Stem and branches are penetrated by canals, the thick walls of which contain numerous spicules.

15. *Siphonogorgia*, Kölliker, Festschr. phys.-med. Ges. Würzburg, 1874, pp. 18-23; Klunzinger, Korall. des rothen Meeres, pt. i. p. 48, 1877.

The colony is upright, branched; on the branches and twigs the polyp-heads are distributed or are terminal. The whole mesoderm of the axis and of the thick walls of the canals is packed with numerous large spicules. The polyps are partially retractile.

## Family VIII. HELIOPORIDÆ.

*Helioporidæ*, Moseley, Zool. Chall. Exp., vol. ii. pt. vii. pp. 102, 123.

The compact corallum consists of a fibro-crystalline calcareous mass. This is formed from a cœnenchyma composed of numerous tubes, and from calyces with an

irregular number of septa-like parietal ridges. Calyces and cœnenchymatous tubes are closed below by a series of transverse floors. The polyps are completely retractile, and the tentacles are invaginated. The opening of the pockets, which ensheath the cœnenchymatous tubes, is closed by a layer of delicate tissue. Communication between the individual tubes, and between them and the calyces, is established by a system of delicate, membranous, transverse canals.

*Heliopora*, Blainville, Manuel d'Actinologie, p. 392; Milne-Edwards, Hist. Nat. des Coralliaires, t. iii. p. 230; Moseley, Phil. Trans., vol. clxvi. 1876, pt. i. p. 91; Moseley, Zool. Chall. Exp., vol. ii. pt. vii. p. 103.

## Order II. PENNATULACEA, Verrill.

*Pennatulacea*, Verrill, Proc. Essex Inst., vol. iv. p. 148.

*Pennatulida*, Kolliker.

The Pennatulacea may be derived, as Kolliker has shown, from Cornularid forms, among which the remarkable genus *Pseudogorgia*, Kolliker, may serve as a transition link. For details of this order we refer to Kolliker's monograph.<sup>1</sup> For the sake of completeness, however, we here append the classification given by Kolliker in his Report<sup>2</sup> on the Challenger Pennatulida, with modifications due to the labours of Verrill,<sup>3</sup> Koren,<sup>4</sup> and Danielssen.<sup>5</sup>

### Section I. PENNATULACEA.

#### Subsection I. Penniformes.

#### Family I. PTEROEIDIDÆ.

<i>Pteroeides</i> , Herkl.		<i>Godefroyia</i> , Köll.
		<i>Sarcophyllum</i> , Köll.

#### Family II. PENNATULIDÆ.

<i>Pennatula</i> , Lam.		<i>Ptilosarcus</i> , Gray.
<i>Sciophyllum</i> , Verr.		<i>Halisceptrum</i> , Herkl.

<sup>1</sup> Kolliker, Anat. systemat. Beschreib. d. Alcyon., 1870.

<sup>2</sup> Kolliker, Zool. Chall. Exp., vol. i. pt. ii.

<sup>3</sup> Verrill, Amer. Journ. Sci. and Arts, vol. xxiii., April 1882; Bull. Mus. Comp. Zool., vol. xi. No. 1, 1883.

<sup>4</sup> Koren and Danielssen, Nye Alcyonider, Bergens Museum, 1883.

<sup>5</sup> Daniels-en and Koren, Norske Nordhavs-Exped., Pennatulida, 1884.

Subsection II. **Virgulariææ.**Family I. **VIRGULARIDÆ.**

<i>Virgularia</i> , Lam.		<i>Scytalium</i> , Herkl.
		<i>Pavonaria</i> , Köll.

Family II. **STYLATULIDÆ.**

<i>Stylatula</i> , Verr.		<i>Dubenia</i> , Kor. and Dan.
<i>Suava</i> , Dan. and Kor.		<i>Acanthoptilum</i> , Köll.

Section II. **SPICATÆ.**Subsection I. **Funiculinæ.**Family I. **FUNICULINIDÆ.**

<i>Funiculus</i> , Lam.		<i>Halipteris</i> , Köll.
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Family II. **STACHYPTILIDÆ.**

*Stachyptilum*, Köll.

Family III. **ANTHOPTILIDÆ.**

*Anthoptilum*, Köll.

Subsection II. **Junciformes**Family I. **KOPHOBELEMNONIDÆ.**

<i>Kophobelemnion</i> , Asb.		<i>Sclerobelemnion</i> , Köll.
		<i>Bathyptilum</i> , Köll.

Family II. **UMBELLULIDÆ.**

*Umbellula*, Lam.

Family III. **PROTOCAULIDÆ.**

<i>Protocaulon</i> , Köll. (Verrill suspects that <i>Protocaulon</i> was based on a young <i>Acanthoptilum</i> .)		<i>Cladiscus</i> , Kor. and Dan.
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## Family IV. PROTOPTILIDÆ.

<i>Protoptilum</i> , Köll. (according to Verrill, a young form of <i>Virgularia</i> ).	<i>Trichoptilum</i> , Köll. (according to Verrill, a young form of <i>Funicularia</i> ).
<i>Lygomorpha</i> , Kor. and Dan.	<i>Scleroptilum</i> , Köll.
<i>Microptilum</i> , Köll.	<i>Distichoptilum</i> , Verr.
<i>Leptoptilum</i> , Köll.	<i>Gunneria</i> , Dan. and Korn.

## Section III. RENILLEÆ.

## Family I. RENILLIDÆ.

*Renilla*, Lam.

## Section IV. VERETILLEÆ.

## Family I. CAVERNULARIDÆ.

<i>Cavernularia</i> , Val.	<i>Styloblemnon</i> , Köll.
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## Family II. LITUARIDÆ.

<i>Lituaria</i> , Val.	<i>Policella</i> , Gray.
<i>Veretillum</i> , Cuv.	<i>Clavella</i> , Gray.

## Section V. GOENDULEÆ.

## Family I. GOENDULIDÆ.

*Goendul*, Kor. and Dan.

## Order III. GORGONACEA, Verrill.

*Gorgonacea*, Verrill, Proc. Essex Inst., vol. iv. p. 148.*Acifera*, Gray, Cat. Lithophytes Brit. Mus., p. 1.*Gorgonidæ*, Dana, Milne-Edwards, Klunzinger, etc.

Fixed colonial Alcyonaria with a more or less firm internal axis, which is covered by a cœnenchyma from which the polyps, with their short body cavities, arise.

## Section I. SCLERAXONIA.

*Pseudaxonia*, v. Koch, *Morph. Jahrb.*, Bd. iv. p. 474.

Fixed, upright, branched polyp-colonies; the short polyp-tubes are surrounded by a canaliferous cœnenchyma, in which numerous spicules are embedded. The axis consists of a cortical substance in which the polyps are placed, and a medullary substance. The latter contains spicules which are different in form from those of the cortex. They are generally tightly packed, sometimes they are fastened together by a horny substance, or even cemented into a strong axis by calcareous material. In this, however, the individual spicules have always served as the basis.

The section Scleraxonia is here regarded as a distinct division of the Gorgonacea, since the component families exhibit a close mutual relationship, and diverge in many respects from those of the Holaxonia. The axis, where such a supporting structure occurs, as in the Holaxonia, is always composed of differentiated spicules, which preserve a certain independence even when the axis appears to the unassisted vision as a hard amorphous mass. The variable consistence of the axis is due to the fact that the spicules may either lie loosely together, or be united by a horny substance, or be bound together into a more or less calcareous mass. The lowest forms of the Scleraxonia, such as occur among the Briareidæ, are closely connected to *Sympodium* and *Callipodium*. There is still to be found a more or less flatly expanded colony, in which the cœnenchyma is divisible into a firmer medullary and a softer cortical portion, but instead of clinging to a substratum, as in the above mentioned forms of Cornulariidæ, the colony rises upright, forming a branched tree-like colony as in *Solenocaulon*, Gray, and *Leucoella*, Gray. With further differentiation the medullary mass comes to lie within a cylindrical stem, and thus forms a central axis, which may be more or less specialised, and attains its highest development in *Corallium*.

The section of the Scleraxonia corresponds in great measure with the family Pseudaxonia of v. Koch,<sup>1</sup> which this author regards as exhibiting a quite different mode of axis-formation from that of his Axifera.

Von Koch's Pseudaxonia includes the Corallinacea, Sclerogorgiacea, and Melithæacea. The Briareacea he refers in part to the Alcyoninæ.

The Scleraxonia include the following families :—

I. Briareidæ.		III. Melitodidæ.
II. Sclerogorgidæ.		IV. Corallidæ.

<sup>1</sup> Skelet d. Alcyonarien, *Morph. Jahrb.*, Bd. iv. p. 474, &c.

## Family I. BRIAREIDÆ.

*Briareacea*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 188.*Paragorgiaceæ*, Kölliker, Verhand. phys.-med. Gesch. Würzburg, Bd. ii. p. 11.

Scleraxonia in which the cœnenchyma consists of a polyp-bearing cortex and a medullary substance of closely packed spicules; these are either developed on the surfaces of an upright shrubby-colony, or the latter is relegated to the interior of a cylindrical stem over which is spread the former. In the latter case a more or less well-defined axis is formed which may be penetrated by nutritive canals, or may be quite without them. The Briareidæ thus fall into two subdivisions, Briareinæ and Spongioderminæ.

## Subfamily 1. BRIAREINÆ.

Central mass with nutritive canals.

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|----------------------------------|---------------------------------------|
| 1. <i>Leucoella</i> , Gray.      | 4. <i>Suberia</i> , Studer.           |
| 2. <i>Solenocaulon</i> , Gray.   | 5. <i>Anthothela</i> , Verrill.       |
| 3. <i>Semperina</i> , Kölliker.  | 6. <i>Paragorgia</i> , Milne-Edwards. |
| 7. <i>Briareum</i> , Blainville. |                                       |

## Subfamily 2. SPONGIODERMINÆ.

Central mass without nutritive canals.

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|-------------------------------------|---------------------------------|
| 8. <i>Titanideum</i> , Agassiz.     | 9. <i>Iciligorgia</i> , Ridley. |
| 10. <i>Spongioderma</i> , Kölliker. |                                 |

## Subfamily 1. BRIAREINÆ.

1. *Leucoella*, Gray, Ann. and Mag. Nat. Hist., ser. 4, vol. v. p. 405; Ridley, Rep. Zool. Coll. H.M.S. "Alert," Alcyonaria, p. 355.

The most primitive form of this subfamily is probably that of *Leucoella*, Gray. But of this unfortunately we have only a very incomplete description, so that the relations of the nutritive canals are not clearly known. According to Gray's diagnosis this genus must be very nearly allied to *Solenocaulon*.

2. *Solenocaulon*, Gray, Proc. Zool. Soc. Lond., 1862, p. 34, pl. xxxvi. fig. 1; Gray, Ann. and Mag. Nat. Hist., ser. 3, 1862, p. 147.

*Solenogorgia*, Genth, Zeitschr. f. wiss. Zool., Bd. xvii. p. 429, 1867.*Solenocaulon*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, October 1875, p. 668.

In *Solenocaulon* the colony consists of an upright, often laterally flattened stem portion, which bears polyps chiefly on its margins and on one face. The polyp tentacles,

when at rest, are but slightly infolded. The cœnenchyma consists of two layers, a cortical and a medullary portion. The cortex consists of spicules varying from spindle to club-shaped; it is thick on one face of the axis and contains the polyps. The short alimentary polyp-cavities are sunk into the cœnenchyma, beyond which the anterior œsophageal and tentacular portions project. The medullary portion of the stem exhibits only a very thin cortical layer, which consists of a smooth, delicate ectoderm, and of a very thin layer of mesodermic substance. It contains no polyps. The medullary mass consists of very closely approximated rod-like spicules, which are united by a reticulated mass of horny material.

The nutritive system is formed of a network of very fine nutritive canals which unite the polyps. The canals pierce the entire thickness of the cortical substance, and finally open into larger vessels, which extend in diminishing numbers around the periphery of the medullary substance, and are also in part embedded in the cortical sheath. On the thinner twigs these longitudinal canals occur only in the polyp-bearing surface of the cœnenchyma; on the thicker branches they occur over the whole periphery. It is probable that the mechanical conditions of the upright growth is not favourable for a flattened expansion of the stem and branches, for they become inrolled on the side which does not bear polyps. It thus happens that in the stem and larger branches the margins will often touch so as to form a hollow tube, while the smaller twigs only exhibit a channelled stem. The near relation of such a colony to that of *Sympodium* and associated forms is very marked; there is still the flat expansion of the stem, but this instead of clinging by its lower face to foreign objects, is elevated and grooved so that its under surface becomes the inside of a tubular mass or a furrow. In the upright mode of growth, furthermore, a firmer support is essential, and this is furnished by the better differentiation of the medullary mass.

3. *Semperina*, Kolliker, Verhandl. phys. med. Gesch. Würzburg, N. F., Bd. ii. p. 9.

This genus is nearly related to the last. Here, however, the stem has assumed a more cylindrical form, and the medullary mass becomes more or less the axis of the colony. The axis still remains, however, eccentric, and the polyps, like those of the previous genus, arise predominantly from only one face of the mass.

4. *Suberia*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, October 1878, p. 666.

Here the medullary mass is fairly well differentiated, and forms the central axis of a cylindrical stem. The latter is but slightly branched, and gives off polyps on all sides, but most abundantly on the club-like thickened apical portion. The

anterior portions of the polyps are retractile within a distinct calyx portion. A canalicular system with relatively wide canals sends its ramifications throughout the axis.

5. *Anthothela*, Verrill, Bull. Mus. Comp. Zoöl., vol. xi. No. 1, 1883, p. 40; Proc. Nat. Mus., vol. ii. 1879, p. 199.

*Briareum*, Sars, Faun. litt. Norveg., p. 63.

This genus was established by Verrill for *Briareum grandiflorum*, Sars. The colonies form incrustations, or are upright and branched with a distinct axis formed of spindle-shaped spicules. The polyps are large, projecting, and not retractile, but when closed they terminate in eight lappets, which are formed from the bases of the incurved tentacles. The cœnenchyma of the cortex contains large nutritive canals, fine capillary sap-canals as in the Alcyonidæ, and a few larger longitudinal canals which also perforate the axis. The large polyps possess digestive cavities, which impinge on the axis.

6. *Paragorgia*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 190.

*Briareum (pars)*, Blainville, Manuel d'Actinologie, p. 520.

This genus forms upright, branched, mainly cylindrical colonies, with irregularly distributed polyps having wart-like calyces, into which the anterior portion of the polyps may be withdrawn. The somewhat vaguely defined axis contains large longitudinal canals. Besides the normal polyps (autozooids) *Paragorgia nodosa*, Kor. and Dan., has also siphonozooids without tentacles.

7. *Briareum*, Blainville, Manuel d'Actinologie, p. 520.

Here the colonies form irregularly lobed upright masses. The axis, which is penetrated by canals, is but vaguely defined. The polyps, which are regularly distributed upon the stem, are without calyces and entirely retractile within the substance of the cœnenchyma.

#### Subfamily 2. SPONGIODERMINÆ.

*Paragorgiaceæ*, Kölliker, Verhandl. phys.-med. Ges. Würzburg, N. F., Bd. ii. p. 11.

8. *Titanideum*, Agassiz, MS.; Verrill, Bull. Mus. Comp. Zoöl., No. 3, January 1864, p. 39; Mem. Boston Soc. Nat. Hist., vol. i. pt. iv. 1869, p. 10.

This genus by the shape and habit of the polyps seems allied to the preceding genus (*Briareum*), but has a well-marked stem which is spongy and very spiculose, but firm and

less porous than that of *Briareum*. The polyps are not prominent and are scattered. It has extremely characteristic spicules.

9. *Spongioderma*, Kölliker, Verh. phys.-med. Ges. Würzburg, N. F., Bd. ii. p. 8.

*Solanderia*, Möbius, Nova Acta Acad. Cæs. Leop., Bd. xxix. Tab. 1, 1861.

„ (?) Ridley, Rep. Zool. Coll. H.M.S. "Alert," Alcyonaria, p. 351.

*Homophyton*, Gray, Proc. Zool. Soc. Lond., 1866, p. 27.

In this genus the colony forms a tree-like, branched cylindrical stem, with polyps retractile into their calyces, and there are distinct longitudinal canals in the periphery of the axis. The spicules are well figured by Dr. Möbius, who has corrected his mistake of describing some siliceous spicules as those of the Alcyonarian.

10. *Iciligorgia*, Ridley, Report Zool. Coll. H.M.S. "Alert," Alcyonaria, p. 351 ;  
? Duchassaing, Revue des Zoophytes et des Spongiaires des Antilles (Paris 1870), p. 12.

The colony is upright and branched; the stem and branches are compressed, irregular in section; the completely retractile polyps occur in a row within a groove along the sharp edges of the branches. The medullary mass forms an axis of spicules. It is close, but brittle in texture, not penetrated by, but surrounded by, longitudinal canals. While there is no doubt of the genus described by Ridley, it does not seem quite certain if it be the same as that described by Duchassaing.

## Family II. SCLEROGORGIDÆ.

*Sclerogorgiaceæ*, Kölliker, Icones histiologicæ, pt. ii. p. 142.

In the representatives of this family a distinct axis is formed of a tissue consisting of numerous closely intercalated elongate spicules with dense horny sheaths. The axis is surrounded by longitudinal canals, into which there open the reticulated cœnenchymatous canals uniting the polyps. The polyps exhibit a wart-like protruding calyx portion, within which the tentacles may be completely retracted.

In *Suberogorgia suberosa* (Esp.), the stem and branches are flattened, the polyps arise especially from the narrow margins, while the naked surfaces of the stem and branches exhibit a deep longitudinal groove. Below this latter lie the wide longitudinal canals, one on each side of the axis. These vessels are in communication with the network of canals distributed in the cœnenchyma.

1. *Suberogorgia*, Gray.

| 2. *Keroeides*, Wright and Studer.

1. *Suberogorgia*, Gray, Proc. Zool. Soc. Lond., 1857, p. 159.

*Sclerogorgia*, Kölliker, Icones histiologicæ, pt. ii. pp. 142, 144, 1865.

The colonies are upright, branched, the branches sometimes anastomosing. Polyps with slightly protruding calyces, which are especially distributed on either side of the somewhat flattened stems and branches. The cœnenchyma is thick, and exhibits longitudinal furrows on the surface of the areas which are free from polyps. The spicules are warty spindles, and in one species birotate.

2. *Keroeides*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. 1, p. 30.

The upright colony branches in one plane; the polyps form wart-like verrucæ, which are given off mainly from two sides of the somewhat flattened branches, leaving an interspace free. The spicules of the cœnenchyma are large broad spindles and polygonal, often triangular discs. These latter are closely approximated to one another, and form a pavement-like outer layer in the cœnenchyma. The calyces are thickly covered with polygonal scales, and the tentacles also contain broad smooth spicules. The whole habit, and even the character of the spicules, recall the genus *Acis*.

The axis is colourless and consists of closely intercalated calcareous spindles enclosed in a horny fibrous substance, which remains and preserves the form of the axis after decalcification.

### Family III. MELITODIDÆ.

*Melithæidæ*, Ridley, Rep. Zool. Coll. H.M.S. "Alert," Alcyonaria, p. 356.

*Melithæacæ*, Kölliker, Icones histiologicæ, pt. ii. p. 142.

*Melithæadæ*, *Mopselladæ*, *Trinelladæ*, *Elliselladæ* (*vars*), Gray, Cat. Lithophytes Brit. Mus. pp. 3, 5, 12, 24.

Scleraxonia with a well-marked axis, which is jointed, *i.e.*, consisting of alternating portions of a hard calcareous and of a soft horny substance. The hard joints (*internodes*) consist of fused calcareous spicules, with but a trace of horny substance; the soft joints (*nodes*) are formed of loose calcareous spicules, in a mesh of horny substance.

Gray made of this group a number of distinct families, but these, as Ridley has shown,<sup>1</sup> cannot be upheld. Ridley proved that the difference on which Gray relied in distinguishing Melithæidæ and Mopselladæ, namely, the penetration of the axis by nutritive canals, is not persistent, and he refers the genera to one family, and distinguishes them only by the characters of their spicules. The Melitodidæ may be possibly derived from the Briareidæ. Like the lower forms of the latter many Melitodidæ exhibit nutritive canals within the axis. Ridley thinks that siphonozooids may occur as in *Paragorgia* beside the autozooids. An example of this dimorphism, he thinks, is

<sup>1</sup> *Loc. cit.*, p. 356.

furnished by *Melitodes albocincta*, Ridley, but it is possible this may be a sexual distinction among the autozooids. We adopt the name Melitodidæ for the family, from its typical genus, and the following genera may be accepted :—

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|--|----------------------------------|
| 1. <i>Melitodes</i> , Verrill.                   | 4. <i>Psilacabaria</i> , Ridley. |
| 2. <i>Mopsella</i> , Gray, <i>emend.</i> Ridley. | 5. <i>Wrightella</i> , Gray.     |
| 3. <i>Acabaria</i> , Gray.                       | 6. <i>Clathraria</i> , Gray.     |
| 7. <i>Parisis</i> , Verrill.                     |                                  |

1. *Melitodes*, Verrill, Bull. Mus. Comp. Zoöl., vol. i. p. 38, 1863.

*Melitæa*, Lamarck, Mém. Mus. Hist. Nat. Paris, t. i. p. 410, 1815 (preoccupied by Fabricius, 1808).

In the species of this genus all the joints are penetrated by longitudinal canals: the spicules of the cœenchyma are either large warty or kneed-spindles.

2. *Mopsella*, Gray, Proc. Zool. Soc. Lond., 1857, p. 248.

*Melitella*, Gray, Proc. Zool. Soc. Lond., 1859, p. 485.

*Mopsella*, *emend.* Ridley, Rep. Zool. Coll. H.M.S. "Alert," Alcyonaria, p. 258.

In the species of this genus also the thicker joints of the axis are penetrated by canals. The spicules are spindles and foliaceous clubs.

3. *Acabaria*, Gray, Ann. and Mag. Nat. Hist., ser. 4, vol. ii. p. 444.

Like *Mopsella*, but the spicules of the cortex are solely spindles.

4. *Psilacabaria*, Ridley, Rep. Zool. Coll. H.M.S. "Alert," Alcyonaria, p. 363.

Without foliaceous clubs. The branches arise from the nodes almost at right angles. The annular tubercles have large spindle-shaped cortical spicules. The polyps are spirally disposed.

5. *Wrightella*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 31, *emend.* Ridley, Rep. Zool. Coll. H.M.S. "Alert," Alcyonaria, p. 580.

*Mopsea*, Klunzinger, Korall. des rothen Meeres, pt. ii. 1877, p. 57.

The branches and twigs are compressed; the projecting polyp calyces occur especially on the sides. In the cortex there are foliaceous clubs. There are no nutritive canals in the axis.



6. *Clathraria*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 11 : Proc. Zool. Soc. Lond., 1859, p. 486.

Cylindrical, manifoldly curved branches, often anastomosing, and of uniform thickness throughout. The polyps are sunk into the cœnenchyma. The axis includes no nutritive canals. Spicules in cortex, broad and short foliaceous clubs.

7. *Parisis*, Verrill, Bull. Mus. Comp. Zool., 1864, No. 3, p. 37.

In contrast to the general rule among the Melitodidæ, the branches here arise from the internodes. The protruding calyces arise on the smaller branches over the entire margin. The spicules remind one of those of *Isis*; they are thick, irregular, often constricted in the middle and beset with warts. *Trinella swinhoei*, Gray, for which Gray established his genus *Trinella*, was based on the axis of a *Parisis*, overgrown by a siliceous Sponge, and bearing the polyps of a *Palythoa*, which Gray mistook for Alcyonarian polyps.

#### Family IV. CORALLIDÆ.

*Corallidæ*, Gray, Proc. Zool. Soc. Lond., 1857, p. 286; Ann. and Mag. Nat. Hist., 1859, ser. 3, vol. iv. p. 444; Proc. Zool. Soc. Lond., 1859, p. 480; Cat. Lithophytes Brit. Mus., 1870, p. 22; Ridley, Proc. Zool. Soc. Lond., 1882, p. 221.

*Corallinæ*, Dana, U.S. Explor. Exped., 1846, p. 639; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 201.

The axis consists of a dense calcareous mass the result of spicules fused together. Both auto- and siphonozœoids occur.

Ridley<sup>1</sup> has pointed out the close relationship between the Corallidæ and Melitodidæ.

- |                                |  |                                   |
|--------------------------------|--|-----------------------------------|
| 1. <i>Corallium</i> , Lamarck. |  | 2. <i>Pleurocorallium</i> , Gray. |
|--------------------------------|--|-----------------------------------|

1. *Corallium*, Lamarck, Hist. Nat. Anim. sans Vert., ed. 1, 1816, t. ii., p. 295; Lacaze Duthiers, Hist. Nat. du Corail, Paris, 1864; Ridley, Proc. Zool. Soc. Lond., 1882.

The genus *Corallium*, represented by the precious coral (*Corallium rubrum*), has only one kind of spicule, and the calyces of the polyps occur over the entire surface of the colony.

<sup>1</sup> *Loc. cit.*, *supra*, pp. 221-233.

2. *Pleurocorallium*, Gray, Proc. Zool. Soc. Lond., 1867, p. 125; Cat. Lithophytes Brit. Mus., 1870, p. 23; Ridley, Proc. Zool. Soc. Lond., 1882.

The species of this genus contain two kinds of spicules, and the polyps are mainly restricted to one surface of the compressed stem and branches.

## Section II. HOLAXONIA.

*Azifera*, v. Koch, Morph. Jahrb., Bd. iv. pp. 474, 476.

Gorgonacea with an axis which consists of horny material, or of a calcified horny substance, or of alternating joints of amorphous calcareous material and horn.

The formation of the colonies in the Holaxonia appears to proceed on a somewhat different plan from that observed in the Scleraxonia. For while in the latter the axis first appears as a differentiation of the cœenchyma at the original basal expansion of the colony, in Holaxonia it is formed from the beginning as a central support to the colony, and it is surrounded peripherally by the longitudinal canals.

The Holaxonia include the following families:—

V. Dasygorgidæ.		IX. Plexauridæ.
VI. Isidæ.		X. Gorgonidæ.
VII. Primnoidæ.		XI. Gorgonellidæ.
VIII. Muriceidæ.		

The Dasygorgidæ may be regarded as containing the most primitive forms. The polyps are non-retractile; the tentacles, which are furnished with spicules, are simply coiled, when at rest, over the oral disc. The axis is at once horny and calcareous. In one direction this family leads on to the Isidæ where the axis is differentiated into alternate horny and calcareous portions, and where, at least in some forms, the polyps are like those of the Dasygorgidæ.

From the subdivision Chrysogorginæ of the Dasygorgidæ, in which the spicules of the polyps are scale-like, the Primnoidæ may have been derived. In certain forms in which the parts of the polyp bodies are but slightly differentiated, the Muriceidæ also suggest an origin from Dasygorgidæ; though in other forms the differentiation of the polyps into a calycine and a retractile tentacular region becomes more pronounced, until finally in the genus *Muricea* there is a transition to the Plexauridæ, where the anterior portion of the polyp may be completely protected within the calyx or within a deep cœenchymatous cavity. The Gorgonidæ may be regarded as a special division arising from the Muriceidæ or Plexauridæ, and they finally lead on by the calcification of the axis to the usually biradial colonies of Gorgonellidæ. The differentiation of the type may be hypothetically indicated in this scheme:—



(*Herophila*) were the next. These genera were referred to the Gorgonellidæ. Under the name *Chrysogorgia* two corals were diagnosed and figured,<sup>1</sup> but the second is probably to be referred to the Primnoidæ. Verrill has taken the first described form as the type of the amended genus *Chrysogorgia*.

Verrill has described<sup>2</sup> some new forms of Alcyonaria allied to *Chrysogorgia desbonni*, Duch. and Mich., for which he established the genera *Dasygorgia* and *Iridogorgia*, and formed for them and *Chrysogorgia* the family Chrysogorgidæ. The discovery of several new species of *Dasygorgia* in the Challenger collection, and of a new genus characterised by the presence of an unbranched stem (*Strophogorgia*) has induced us to unite all the genera in one family of Dasygorgidæ, with the two subfamilies Strophogorginæ and Chrysogorginæ.

#### Subfamily 1. STROPHOGORGINÆ.

##### 1. *Strophogorgia*, Perceval Wright.

#### Subfamily 2. CHRYSOGORGINÆ.

- |  |  |                                  |
|--|--|----------------------------------|
| 2. <i>Chrysogorgia</i> , Duch. and Mich. |  | 4. <i>Dasygorgia</i> , Verrill.  |
| 3. <i>Herophila</i> , Steenstrup.        |  | 5. <i>Iridogorgia</i> , Verrill. |

#### Subfamily 1. STROPHOGORGINÆ.

Axis simple, rod-like, arising from a calcareous base ramifying into root-like processes. The polyps are cylindrical, projecting obliquely upwards from the stem. The spicules are rod-like or lenticular.

1. *Strophogorgia*, Perc. Wright, Narr. Chall. Exp., vol. i. p. 691, 1883.

#### Subfamily 2. CHRYSOGORGINÆ.

*Chrysogorgidæ*, Verrill, Bull. Mus. Comp. Zool., vol. xi. No. 1, p. 21, 1883.

The colony is branched, consisting of a main axis around which the branches are spirally disposed; these may give off secondary twigs. The polyps are relatively large, arising at right angles or obliquely from the branches, flask- or club-shaped. The spicules are semi-opaque, flattened, and irregular in form, scale-like. In many species siphonozooids are present.

2. *Iridogorgia*, Verrill, Bull. Mus. Comp. Zool., vol. xi. No. 1, pp. 21, 26, 1883.

Branches simple, occurring in spirals round the main axis. Siphono- and autozooids. The latter are flask-shaped. The spicules are smooth and rod-like.

<sup>1</sup> *Tom. cit.*, p. 13, pl. i. figs. 7, 8.

<sup>2</sup> *Bull. Mus. Comp. Zool.*, vol. xi. No. 1, p. 21.

3. *Dasygorgia*, Verrill, Bull. Mus. Comp. Zoöl., vol. xi. No. 1, p. 21, 1883.

The colony is branched, and consists of a main axis and of spirally disposed branches, which are branched after the manner of a helicoid cyme. The polyps are thick and distended at their bases. The spicules are scale-like, usually smooth, or slightly dentate at their margins.

4. *Chrysogorgia*, Duchassaing and Michelotti, Mém. Cor. des Antilles, p. 21, pl. iv. figs. 5, 6; *emend.* Verrill, Bull. Mus. Comp. Zoöl., vol. xi. No. 1, p. 21.

The branching of the colony as in the preceding genus. The polyps are narrowed at their bases, and covered with rather long spiny spicules, which are at the base of the polyps placed more or less transversely. The spicules of the cœnenchyma are long warty spindles.

5. *Herophila* (in manuscript, *Herophile*, *fide* Lütken); Steenstrup, Oversigt. K. D. Vid. Selsk. Forhandl., 1860, pp. 126–133.

*Riisea*, Duch. and Mich., *loc. cit.*, p. 18, pl. lxi. figs. 1, 2, 3, 1861.

The colony is branched. The polyps are club-shaped and arise near the ends of the short twigs, beyond which a short, blunt stolon projects. The tentacles bend completely inwards. The spicules are small, warty spindles.

## Family VI. ISIDÆ.

*Isidinæ (pars)*, Milne-Edwards, Hist. Nat. des Coralliaires, vol. i. p. 192.

*Mopseidæ*, *Acanellidæ*, *Keratoisidæ*, and *Isidæ*, Gray, Cat. Lithophytes Brit. Mus., pp. 13, 16–19.

*Isidæ (pars)*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 661.

*Isidinæ et Melithæaceæ*, Kölliker, Icones histiologicæ, pt. ii. pp. 140–142.

In this family we include all the Holaxonia in which the axis consists of alternating horny and calcareous portions. The horny joints (nodes) are composed of a connective-tissue, which is irregularly calcified in delicate threads. The calcareous material is amorphous. The cœnenchyma, the polyps, and the spicules vary much in the different genera. Three subfamilies may be distinguished. The first, that of the Ceratoisidinæ, seems closely related to the Strophogorginæ. The polyps are relatively large, and either imperfectly or non-retractile; they rise from a thin cœnenchyma. The spicules are for the most part smooth needles, which extend on into the tentacles. In the second subfamily, the Mopseinæ, the polyps are club-shaped, and the tentacles when at rest are

laid together so as to close over the oral cavity as with an operculum. The cœnenchyma and polyps are covered with a layer of scales, the margins of which are dentate. In the third subfamily, the Isidinæ, the polyps are sunk into a thick cœnenchyma, and no external calyces have been developed.

Subfamily 1. CERATOISIDINÆ.

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|--|-------------------------------|
| 1. <i>Bathygorgia</i> , Perceval Wright. | 4. <i>Acanella</i> , Gray.    |
| 2. <i>Ceratoisis</i> , Perceval Wright.  | 5. <i>Isidella</i> , Gray.    |
| 3. <i>Callisis</i> , Verrill.            | 6. <i>Sclerisis</i> , Studer. |

Subfamily 2. MOPSEINÆ.

- |  |                               |
|--|-------------------------------|
| 7. <i>Primnoisis</i> , Wright and Studer.  | 8. <i>Mopsea</i> , Lamouroux. |
| 9. <i>Acanthoisis</i> , Wright and Studer. |                               |

Subfamily 3. ISIDINÆ.

10. *Isis*, Linneus.

Subfamily 1. CERATOISIDINÆ.

*Keratoisidæ*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 18.

*Acanelladæ*, Gray, *tom. cit.*, p. 16.

*Mopseadæ*, Gray, *tom. cit.*, p. 13.

*Ceratoisidæ*, Verrill, Bull. Mus. Comp. Zool., vol. xi. p. 9, July 1883.

The colonies are simple, rod-like, or branched; they rise from a calcareous base usually ramified into root-like processes. The calcareous internodes are very long in comparison with the horny nodes, and in the younger portions are penetrated by a canal. The cœnenchyma is thin; the polyps are long, and imperfectly or non-retractile. The tentacles when at rest are folded over the oral disc or sometimes partially invaginated. The cœnenchyma and polyps, and sometimes also the polyp tentacles, are covered with large, smooth, needle- or spindle-shaped spicules.

1. *Bathygorgia*, Perceval Wright, Narr. Chall. Exp., vol. i. p. 691, fig. 236.

The colony is unbranched, the axis consists of very long calcareous internodes, and short horny nodes. The polyps arise only on one side, are large in size, somewhat constricted medianly, and thickened towards base and apex. The tentacles at rest lie folded horizontally over the oral disc. Cœnenchyma and polyps are covered with flat smooth spicules of a long oval form. These lie transversely in the tentacles, one or two occupying the breadth of each. On the polyps, over the layer of small spicules, some large, obliquely or longitudinal placed spicules, club- or biscuit-like in shape, are to be found.

2. *Ceratoisis*, Perceval Wright, Ann. and Mag. Nat. Hist., December 1868, p. 427, January 1869, p. 23 ; Gray, Cat. Lithophytes Brit. Mus., 1870, p. 18 ; Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, Bd. xi. p. 10, July 1883.

The colony is simple or branched, in the latter case with branches arising from the calcareous internodes. These latter are long, and hollow when young. The cœnenchyma contains long, smooth spindles or needle-like spicules. In the polyps, which are non-retractile, there are large needles. One row of these spicules is so disposed, that one of them lies at the base between each pair of tentacles and projects beyond them, the result being a circlet of diverging spines round about the oral region.

[*Lepidisis*, Verrill, Bull. Mus. Comp. Zoöl., vol. xi. pp. 10, 18, 1883.

The colony is simple or branched. The branches arise from the horny nodes. The cœnenchyma includes an outer layer of small, elongated, scale-like spicules, sometimes intercalated with small spindle-shaped spicules. The large polyps exhibit at the base of the tentacles eight large needle-like spicules alternating with the tentacles; the polyp-walls include large spindle-shaped spicules, more or less covered by an outer layer of small elongated scales.

It seems difficult to separate the unbranched species of this genus from the unbranched species of *Ceratoisis*. In *Ceratoisis* also and indeed in the typical forms of Wright and Studer, the cœnenchyma also includes scale-like flat spicules. The predominance of these over the long needles leads to forms where the cœnenchyma is externally smooth and thick, as for instance in *Ceratoisis grandiflora*, Studer. The polyps, however, are in both cases of similar structure. It is perhaps advisable provisionally to unite *Lepidisis* and *Ceratoisis*.]

3. *Callisis*, Verrill, Bull. Mus. Comp. Zoöl., vol. xi. p. 9, July 1883.

The colony is branched; the calcareous internodes of the axis are solid or very slightly hollow; the branches spring from the calcareous internodes. The short polyps contain spindle-shaped spicules. The cœnenchyma is furnished with a layer of flat, scale-like spicules.

4. *Acanella*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 16; *emend.* Verrill, Bull. Mus. Comp. Zoöl., vol. xi. p. 21, 1883.

The axis of the colony may be simple or branched. The axis has long calcareous internodes and short horny nodes. The branches arise from the nodes, often in whorls. The cœnenchyma is thin, with long spindle-shaped spicules, which form a circlet of needles around the base of the tentacles. The tentacles contain numerous spicules.

5. *Isidella*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 15.*Isis*, v. Koch, Morph. Jahrb., Bd. iv. p. 112.

The colony is branched. The axis consists of long internodes and short nodes ; from the latter the branches are given off. The cœnenchyma is furnished with small acicular spicules with a few small spines. In the walls of the polyps the acicular spicules are large with small spines; the largest are to be found between the bases of each pair of tentacles, but only project beyond these in the dried specimen. The tentacles contain small spindle-shaped spicules, which extend into the very pinnae.

This genus is very nearly related to *Acanella*, but differs in the more spiny character of the spicules and in the mode of branching. Gray referred four species to this genus. Of these *Isis neapolitana*, v. Koch (= *Mopsea mediterranea*, Risso, = *Mopsea elongata*, Phil., and doubtfully *Isis elongata*, Esper) has been carefully investigated by v. Koch. This form may be regarded as the type of the genus. To judge from the nature of the axis, which alone is known, it is possible that *Isis gracilis*, Lamrx., also belongs here ; whether this is also true of *Isis coralloides*, Lam., is doubtful.

6. *Sclerisis*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 661.

The colony is upright and branched, with long finely-furrowed internodes and short disc-shaped nodes. The branches spring from the internodes. The cœnenchyma is very thin and without spicules. The calyces are bell-shaped, with constricted bases, and are covered with large, curved, spinose spicules, which lie closely approximated. Over the oral region of the polyp the large spicules form a quasi operculum. The genus forms a transition towards the next subfamily.

## Subfamily 2. MOPSEINÆ.

*Mopseidæ*, Gray (*pars*).

The colony is branched, the polyps, which are cup- or club-like, or cylindrical in shape, have the tentacles folded over the oral region when at rest. The axis consists of alternate calcareous internodes and horny nodes ; the branches spring for the most part from the former, but sometimes so much on the upper border thereof, that the branch node comes into contact with the stem node, giving the appearance as if it arose therefrom. The spicules of the cœnenchyma are elongated and flattened with very zigzag dentate margins. These dentations mutually interlock, bringing the adjacent spicules into intimate contact. In the polyps the spicules are transversely disposed, and conform to the outline of the polyp wall. In the tentacles there are usually three longitudinal rows of spicules.

This subfamily contains the following genera, of which the first, *Primnoisis*, seems allied to *Dasygorgia*.



7. *Primnoisis*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. i. p. 46, 1887.

The colony is branched in several planes, the polyps arising at wide intervals and being spirally arranged. In the polyps the calyx scales are large, and the mesenteric folds are crowded with small spicules.

8. *Mopsea*, Lamouroux, Hist. des Corall. flexibles, p. 468, Caen, 1816.

The colony is branched in one plane. The polyps are small, club-like in form, and arranged in dense spirals round about the stem. The calyx scales are small, short, and spiny.

9. *Acanthoisis*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. i. p. 46, 1887.

The colony is branched and expanded, fan-like in one plane. The polyps are inconspicuous, cylindrical in form; when contracted the apical region is truncated. The calyx scales are short and spiny. The internodes are furrowed, with dentated ridges.

### Subfamily 3. ISIDINÆ.

The colonies are branched, with a thick cœenchyma, within which the polyps can be wholly withdrawn. The spicules are radiately stellate and covered with rough warts, of which there may be six, eight, or twelve on each. Some simple club-like forms also occur. This subfamily contains but the one genus—

10. *Isis*, Linneus.

## Family VII. PRIMNOIDÆ.

*Primnoaceæ* (*pars*), Valenciennes, Comptes rendus, t. xli. p. 7, 1855.

*Primnoaceæ* (*pars*), H. Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 188, 1857.

*Primnoidæ*, Gray, Proc. Zool. Soc. Lond., 1857, p. 285; *Op. cit.*, 1859, p. 483.

*Primnoaceæ* (*pars*), as a division of subfamily Gorgoninæ, Kölliker, Icones histiologicæ, pt. ii., 1865, p. 135.

*Primnoidæ* (*pars*), Verrill, Trans. Connect. Acad., vol. i., 1869, p. 418; Revis. Polyps East Coast North America, Mem. Boston Soc. Nat. Hist., vol. i., 1884, p. 8.

*Primnoidæ* (*pars*), *Calligorgioidæ* (*pars*), *Calyptraphoridæ*, Gray, Cat. Lithophytes Brit. Mus., 1870, pp. 34, 41, 43.

*Primnoaidæ* (subfamily), Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 641.

*Primnoidæ* (*emend.*), Verrill, Bull. Mus. Comp. Zool., vol. xi. p. 28, 1883.

Holaxonia with a calcareous and horny axis, basal attachment always calcareous. The polyps with a projecting, usually club-shaped calycine portion, tentacular portion retractile.

The cœnenchyma contains a superficial layer of scale-like calcareous bodies, which are continued upwards over the calyx, where they are arranged in regular sequence, usually bilaterally symmetrical, they overlap each other around the margin of the calyx; eight of the scales form an operculum, and they may be brought together so as to close the opening. The calyces are movable; they are thrust outwards when erect, or are when retracted turned towards the stem, so as to lay their oral apertures against the stem. In some species this retraction is also accompanied by a twisting of the base of the calyx, which turns the oral aperture downwards.

The Primnoidæ are a well-marked family, without any close relationship with the Muriceidæ with which they have been usually united. The opercula which close the calyces of the Muriceidæ are formed of the spicular bases of the tentacles, while in the Primnoidæ they are portions of the calyx. The nearest relationship of the Primnoidæ seems to be with certain forms of Chrysorgoginæ.

The Primnoidæ may be divided into the following four subfamilies and genera:—

Subfamily 1. CALLOZOSTRINÆ.

1. *Callozostron*, Perceval Wright.

Subfamily 2. CALYPTROPHORINÆ.

2. *Calyptrophora*, Gray, *emend.*

Subfamily 3. PRIMNOINÆ.

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|---|---|
| 3. <i>Primnoa</i> , Lamouroux.                      | 7. <i>Thouarella</i> , Gray, <i>emend.</i>          |
| 4. <i>Stachyodes</i> , Wright and Studer.           | 8. <i>Amphilaphis</i> , Wright and Studer.          |
| 5. <i>Calypterinus</i> , Wright and Studer.         | 9. <i>Plumarella</i> , Gray, <i>emend.</i>          |
| 6. <i>Stenella</i> , Gray.                          | 10. <i>Primnoella</i> , Gray, <i>emend.</i> Studer. |
| 11. <i>Caligorgia</i> , Gray, <i>emend.</i> Studer. |   |

Subfamily 4. PRIMNOIDINÆ.

12. *Primnoides*, Wright and Studer.

Subfamily 1. CALLOZOSTRINÆ.

The colony consists of a probably creeping stem, which is either attached or free, a point which cannot be decided on the single specimen which is the representative of this subfamily. The axis is feebly calcareous and flexible. The elongated polyps are cylindrical, and arranged in rows; they arise thickly on the entire stem, except along one longitudinal surface which may be described as the ventral colonial groove, and

probably represents that on which the colony rests. The apex of the colony consists of a pointed, knob-like stolon, which bears no polyp. The polyps are covered with large, imbricate scales, of which those of the last row are continued into long spine-like processes. The operculum of eight scales is well developed. Twelve longitudinal canals surround the axis; these increase in diameter towards the ventral groove. They are symmetrically arranged at either side of an axis represented by a line drawn at a right angle from the middle of the ventral groove to the opposite region of the periphery.

1. *Callozostron*, Perceval Wright, Narr. Chall. Exp., vol. i. p. 691, 1885.

The diagnosis of the subfamily will serve for the genus.

#### Subfamily 2. CALYPTROPHORINÆ.

*Calyptrophoradæ*, Gray, Cat. Lithophytes Brit. Mus., p. 41, 1870.

Colony usually branched; the calyces bilaterally symmetrical, enclosed within scales; eight scales compose the operculum. Two scales guard the base of the polyp, and above these there are two others which surround the calyx and are articulated with one another. The first of these, which rests on the two basal scales, is externally broad and high, the margins are sometimes continued into divergent spines, while internally the edges narrow and turn inwards so as to form a ring around the ventral aspect of the polyp. The second is attached to the internal margin of the former, it is also much broadened externally and often toothed, while internally it also forms a narrow ring. The upper scale can be bent inwards at an angle upon the lower. The opercular pieces are symmetrically distributed on the dorso-ventral plane, so that the dorsals, those furthest from the stem, are the largest, and the ventrals the smallest.

2. *Calyptrophora*, Gray, Proc. Zool. Soc. Lond., 1866, p. 25; Gray, Cat. Lithophytes Brit. Mus., 1870, p. 41; Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 642.

The diagnosis of the subfamily may suffice for the genus.

#### Subfamily 3. PRIMNOINÆ.

The colonies are of variable form, sometimes simple, sometimes branched. The polyp calyces are mostly bilateral; the dorso-ventral axis is directed at right angles to the longitudinal axis of the stem. The polyp calyces can be bent inwards towards the stem, and are often at the same time twisted upon their bases. The individual calyx scales never surround the entire periphery of the calycine portion, but there are at least two in each transverse girth. The larger scales form the dorsal and lateral wall

of the calyx, the ventral surface forming a narrow space, which is either naked or is covered with small scales. The cœnenchyma usually contains small elongated scales.

3. *Primnoa*, Lamouroux, Hist. des polyp. flexibles, p. 440, 1816; Expos. méthod. de l'Ordre des polypiers, p. 37; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 139 (*pars*); Gray, Cat. Lithophytes Brit. Mus., 1870, p. 44.

*Prymnoa*, Ehrbg., Corallen. des rothen Meeres, 1834, p. 133.

*Lithoprímnoa*, Grube, Abhandl. d. schles. Ges. Naturw. u. Med., 1861, p. 165.

The colony is branched. The polyps occur in close spirals over the entire periphery of the stem and branches. Each polyp calyx is enclosed dorsally and laterally by two large scales, of which there are two longitudinal overlapping rows, the upper margin of one scale always overlapping the lower border of the next. There is a ventral space destitute of scales, except at the calyx margin, where four are present, forming with the two pairs of dorso-lateral scales an operculum. The calyces can be turned downwards from the stem.

4. *Stachyodes*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. i. p. 49.

The colony is but feebly branched. The calyces arise in regular whorls of five from the stem and branches. The scales of the polyp calyces are disposed in a manner analogous to that observed in the preceding genus. The polyp calyces when at rest are turned downwards.

5. *Calypterinus*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. i. p. 49.

The colony is simple and rod-like. The polyp calyces occur in whorls of five to seven around the stem. The polyps do not, however, surround the whole stem, but leave on one side a space free from polyps. Since this occurs in the same position in all the whorls, a region comparable to that in *Callozostron* occurs along the entire stem. In contrast to the portion containing the polyps, the space appears as a deep groove, which is formed into a canal by the curvature round it of the expanded margins of a scale from the adjacent polyp calyces on either side. The polyp calyces are covered by dorsal and lateral scales arranged in two longitudinal rows. The two basal scales of these rows are very large and wing-like, above these are two median scales, and then the superior pair which support the opercular scales.

6. *Stenella*, Gray, Cat. Lithophytes Brit. Mus., p. 48, 1870.

The colony is sometimes simple, but usually branched; the polyp calyces are large, and arise from the axis at right angles either in opposite pairs or in whorls of three.

The polyp whorls are often separated by wide intervals. Large scales, externally smooth and concave, surround the polyp calyx, which seems to possess but slight powers of curving inwards towards the axis. The ventral surface of the polyps is sometimes strengthened by small scales. The spicules of the cœnenchyma are large roundish scales.

7. *Thouarella*, Gray, Cat. Lithophytes Brit. Mus., p. 45, 1870.

The colony is branched. The branches arise at right angles, usually from three sides of the axis. The polyps are club- or cup-shaped, and are placed on the stem in short ascending spirals, which are usually formed of three polyps. Rarely the polyps arise opposite to one another. The scales are different on the dorso-lateral and on the ventral surfaces of the bilateral polyp calyx. The dorso-lateral scales are strongly convex on their upper margin, towards which small protuberances radiate outwards from the centre of each scale. Frequently these protuberances fuse and form elevated ribs, which end in teeth-like projections on the margins of the scales. Sometimes the median rib projects as a long spine. The ventral scales are small, delicate plates, which usually form two longitudinal rows. The new polyp calyces arise on the apices of the twigs.

8. *Amphilaphis*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. i. p. 50.

The colony is branched in one plane. The club-shaped polyps arise at variable intervals from one another around the circumference of the stem, its branches, and twigs, but for the most part from four different sides of the periphery. The scales of the polyp calyx and of the cœnenchyma are thick, and covered with strong wart-like protuberances, which fuse to form ridges on the calyx scales and end on the margin as spines. The operculum, which consists of eight scales, forms a low cone. The young polyps are developed at the apices of the twigs.

9. *Plumarella*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 36; Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1870, p. 648.

The colony is branched in one plane, plume-like. The axis is very calcareous and hard. The polyp calyces are small, cylindrical in form, arising in alternate succession from each side of the axis, usually at relatively great intervals from one another. The polyp calyx scales are thin, cycloid, with a central nucleus.

10. *Primnoella*, Gray, Proc. Zool. Soc. Lond., 1857, p. 286.

The colony is simple, rod-like, rising from a calcareous base. The polyp calyces arise from the stem in whorls of from four to twenty at more or less distant intervals from one

another. The polyp calyces are distinctly bilateral. The calyx scales form longitudinal rows; an individual scale usually overlaps for half its length the adjoining scale. The dorso-lateral surfaces of the calyx are usually covered by two longitudinal rows of scales; the ventral side has small, flat disc-like scales. The shape of the calyx scales is irregularly quadrangular, the nucleus is always excentric, and from it small protuberances radiate outwards. The new polyps arise between the existing whorls.

#### 11. *Caligorgia*, Gray (*emend.* Studer).

*Cullogorgia*, Gray, Proc. Zool. Soc. Lond., 1857, p. 286; *Ibid.*, 1859, p. 484.

*Calligorgia*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 35.

*Culligorgia*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 645.

The colony is upright, and branched in one plane. The polyp calyces are cylindrical or club-shaped, and occur irregularly distributed upon the stem, but on the branches and twigs in whorls of more than three. The calyx scales call to mind ctenoid fish scales; they are more or less fan-shaped, with ribs which radiate out from the nucleus, and diverging towards the upper margin of the scale end in projecting teeth. Two species referred by Studer to the genus *Narella*, viz., *Narella modesta* and *Narella divaricata* may be for the present included in this genus.

#### Subfamily 4. PRIMNOIDINÆ.

The colony is branched in one plane; the polyps are small and opposite. The spicules are flat, thin scales, which are uniformly disposed over the coenenchyma and the polyp calyces; they overlap one another like the tiles of a house. Opercular scales are not distinctly differentiated, and the opening of the polyp calyx is therefore but imperfectly protected.

#### 12. *Primnoides*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. i. p. 52.

The diagnosis of the subfamily will serve for the genus.

#### Family VIII. MURICEIDÆ.

*Muricea*, Lamouroux, Ehrenberg.

*Primnoaceæ*, Milne-Edwards (*pars*), Hist. Nat. des Coralliaires, t. ii. p. 138.

*Primnoaceæ*, Kolliker (*pars*), Icones histiologicæ, pt. ii. p. 135.

*Muriceidæ* (subfamily), Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 649.

*Muriceidæ*, Verrill, 1883, Bull. Mus. Comp. Zool., vol. xi. p. 30.

Holaxonia, usually with a horny axis, over which there is an outer layer of variously shaped calcareous spicules in the form of spiny discs or half-spiny spindles, spiny stars,

scales or spiny needles. The spines or thorns usually project beyond the surface of the cœnenchyma, and give it a rough or spiny appearance. In the polyps are distinguishable a calycine (not retractile) region, a median œsophageal region, and a tentacular region. The median region can be withdrawn into the calycine portion, so that in the retracted state the tentacular portion rests directly upon the calycine margin. Around the bases of the tentacles lies a ring of peripherally disposed calcareous spindles, forming the collaret. The tentacles fold together down upon the calyx; their bases are well furnished with spicules. When the polyp is contracted the armoured tentacle-bases form an eight-rayed operculum, closing up the calyx.

This family is the richest in specific forms of the Holaxonia. These may be grouped into several genera, chiefly diagnosed from the shape of the spicules, besides which there is to be taken into account the more or less different methods by which the tentacles are retracted within the calyx. This retraction is least developed in *Acanthogorgia* and *Muriceides*, which are, as regards their polyps, nearest perhaps to the Ceratoisidinae. The power of retraction increases, however, in the succeeding genera, until in the case of *Muricea*, complete concealment within the calyx becomes possible. This last genus forms a transition to the Plexauridæ.

In the subjoined list, all the genera which have been fully diagnosed by Verrill in his various memoirs are accepted. Of the numerous genera recorded by Gray, only those are retained which have been reinvestigated either by Ridley or the authors. Gray's diagnoses being based upon very trivial characters are in most cases insufficient.

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| 1. <i>Acanthogorgia</i> , Gray, <i>emend.</i><br>Verrill.                    | 11. <i>Echinomuricea</i> , Verrill.                |
| 2. <i>Paramuricea</i> , Kölliker, <i>emend.</i><br>Verrill.                  | 12. <i>Echinogorgia</i> , Kölliker.                |
| 3. <i>Hyphogorgia</i> , Duchassaing and<br>Michelotti.                       | 13. <i>Menacella</i> , Gray, <i>emend.</i> Ridley. |
| 4. <i>Muriceides</i> , Wright and Studer.                                    | 14. <i>Heterogorgia</i> , Verrill.                 |
| 5. <i>Anthomuricea</i> , Wright and Studer.                                  | 15. <i>Astrogorgia</i> , Verrill.                  |
| 6. <i>Clematissa</i> , Wright and Studer.                                    | 16. <i>Bebryce</i> , De Phillipi.                  |
| 7. <i>Villogorgia</i> , Duchassaing and<br>Michelotti, <i>emend.</i> Ridley. | 17. <i>Acamptogorgia</i> , Wright and Studer.      |
| 8. <i>Anthogorgia</i> , Verrill.   | 18. <i>Thesea</i> , Duchassaing and Michelotti.    |
| 9. <i>Menella</i> , Gray.  | 19. <i>Acis</i> , Duchassaing and Michelotti.      |
| 10. <i>Placogorgia</i> , Wright and Studer.                                  | 20. <i>Elasmogorgia</i> , Wright and Studer.       |
|  | 21. <i>Muricella</i> , Verrill.                    |
|  | 22. <i>Eumuricea</i> , Verrill.                    |
|  | 23. <i>Muricea</i> , Auct., <i>emend.</i> Verrill. |

1. *Acanthogorgia*, Gray, Proc. Zool. Soc. Lond., 1857, p. 128 ; Verrill, Bull. Mus. Comp. Zool., vol. xi. No. 1, fig. 30.

*Blepharogorgia*, Duch. and Mich., Supp. Mem. Corall. des Antilles, 1864-66, p. 109.

The colony is branched. The polyp calyces are large, cylindrical, elongated. The calycine spicules are often expanded terminally, into eight long spines projecting over the oral region. On the sides of the calyces the spicules are disposed in eight rows. The cœnenchyma is thin, containing long spindle-shaped spicules.

2. *Paramuricea*, Kölliker, Icones histiologicæ, pt. ii. p. 136, 1865.

*Villogorgia*, Duch. and Mich., *emend.* Ridley, Ann. and Mag. Nat. Hist., vol. ix. p. 187, 1882.

*Paramuricea*, Verrill, *emend.*, Bull. Mus. Comp. Zool., vol. xi. p. 34, 1883.

The colony is branched. The cœnenchyma is thick, with longish rough spindle-shaped and irregular spicules. The polyp calyces are short, cylindrical, or wart-like, they are furnished with a circlet of short projecting needles, which are the apices of large spicules. The spicules of the calyces are disposed in eight rows ; they are for the most part spiny discs, with an elongated smooth spine from the base of which stellate processes radiate. The bases of the contracted tentacles form an eight-rayed operculum, the spicules are disposed *en chevron* on each ray.

3. *Hypnogorgia*, Duchassaing and Michelotti, Supp. Mem. Corall. des Antilles, 1864, p. 21.

*Hypnogorgiada*, Gray ; *Hypnogorgia*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 33.

The colony is upright and branched ; branches pendulous. The polyp calyces arise from two sides of the axis ; they are opposite, or alternate. Their inner surface is attached to the axis of growth. The operculum is elevated and conical. The spicules of the calyx are long spindles, in shape similar to those of the cœnenchyma.

4. *Muriceides*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. i. p. 54.

The colony is but slightly branched. The large projecting polyps spring for the most part from one side of the axis. The operculum formed from the bases of the tentacles is elevated and conical. The spicules in the cœnenchyma and calyx are irregularly disposed spiny spindles, and triple or multiple stellate forms. Of these latter one ray is generally to be found protruding beyond the cœnenchyma. The axis is horny and flexible.



5. *Anthomuricea*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. i. p. 55.

The colony is branched; the polyps occur at tolerably wide intervals from one another, and are disposed in spirals round the stem and branches. In general structure they resemble those of the genus *Paramuricea*. The spicules of the polyps are spinose spindles, and curved thorny clubs, which form eight rows on the polyp-wall, where the spicules are disposed *en chevron*.

6. *Clematissa*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. i. p. 55.

The colonies are branched, with the habit of *Paramuricea*, with a thick cœnenchyma. The polyp calyces are cylindrical, the oral regions of which are usually overarched by an elevated tentacular operculum. The spicules in the calyx wall are thick warty clubs and spinose discs, which are sometimes ramified, but never exhibit any very definite form.

7. *Villogorgia*, Duch. and Mich., Mem. Corall. des Antilles, p. 32, pl. iv. fig. 2, 1860; *emend.* Ridley, Ann. and Mag. Nat. Hist. (*pars*), ser. 5, vol. ix. p. 187, 1882.  
*Brandella*, Gray, Cat. Lithophytes Brit. Mus., p. 30.

The colonies are branched, and are of delicate graceful forms, with thin cœnenchyma. The polyp calyces are of a cylindrical form; they have a slightly protruding, sometimes horizontally disposed, tentacular operculum. Each of the eight opercular coverings consists of three spicules, two converging towards the apex, and one situated medianly between these. The spicules of the calyces are spinose discs like those of *Paramuricea*; those of the cœnenchyma are for the most part quadruple or multiradiate stars.

8. *Anthogorgia*, Verrill, Amer. Journ. Sci. and Arts, vol. xlv. p. 412, May 1868.

The colony is branched, with slender elongated branches. The polyp calyces are strongly projected, of a tubular form, with an eight-rayed operculum consisting of a thin ectoderm, in which large long spindles are embedded at various angles. The cœnenchyma is thin, with large warty spicules.

9. *Menella*, Gray, Ann. and Mag. Nat. Hist., ser. 4, vol. v. p. 407.

According to Gray's diagnosis the colony is unbranched, and thickened terminally. The polyp calyces are thickly set on all sides of the cylindrical stem, and form a rough spiny surface showing hexagonal areas. The polyps are retractile, and form when contracted convex elevations which are surrounded by spicules. The only species, *Menella indica*, Gray, has a cylindrical, terminally thickened stem.

If a species which was collected by Dr. Döderlein in Japan should be included in this genus, the generic diagnosis must be amended. In its general structure the form in question agrees with Gray's description. It consists of a simple rod-like stem with a horny axis. The cortex at the end of the stem is unfortunately wanting, so that it is not possible to decide whether the form was club-shaped or not. The cœnenchyma is thin with a rough surface, on which the spine-like points of the spicules everywhere project. The polyp calyces are disposed in thick spirals round the stem, and form inconspicuous conical warts arising at right angles from it; their oral apertures are surrounded by a circle of spicules. The opercular rays lie horizontally over the mouth. The spicules in the cœnenchyma form a deep layer of warty curved spindles, and above this a layer of spinose discs, each with a smooth terminal apex and basal spiny processes, the apices of which project all over from out of the cœnenchyma, and they form around the margin of each calyx a circle of spines.

10. *Placogorgia*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. i. p. 56.

The colony is branched with a thick cœnenchyma, and with low truncated conical polyp calyces arising at right angles from the axis. The spicules on the calyces are broad, warty discs, often with branched thorny and spiny processes, somewhat resembling those of *Paramuricea*. The warty discs overlap one another on their margins. The tentacular opercula lie horizontally, and consist each of three spicules, two lateral and one median. They are not in contact by their lateral margins.

11. *Echinomuricea*, Verrill, Proc. Essex Inst., vol. vi. p. 45; Amer. Journ. Sci. and Arts, vol. xlvii. p. 285, 1869.

The colony is simple or branched; the stem and branches are thickly beset with the polyp calyces. These are short, cylindrical or conical, truncated terminally, and with horizontally disposed tentacular opercula. The calyces are covered with spicules of a peculiar form overlapping one another; these consist of long flat needles, which give off several root-like processes from their expanded ends. The apices of the needles project.

12. *Echinogorgia*, Kölliker, Icones histiologicæ, pt. ii. p. 136, 1865.

The colony is branched. The polyp calyces, which arise on all sides from the stem and branches, are small and wart-like. The tentacular opercula are but feebly developed, forming low cones. The spicules are in part spiny spindles, and in part spiny clubs and discs.

13. *Menacella*, Gray, Ann. and Mag. Nat. Hist., ser. 4, vol. v. p. 406; *emend.*  
Ridley, Ann. and Mag. Nat. Hist., ser. 5, vol. x. p. 191, 1882.

The colony is in habit like the preceding. The spicules are simple warty spindles with many tuberculated warts.

14. *Heterogorgia*, Verrill, Amer. Journ. Sci. and Arts, vol. xlv. p. 413, 1868.

The colony is branched. The cœnenchyma is thin, with a smooth or finely granular surface. The small spicules occur as rough, warty, short spindles, clubs, double-clubs, double-stars, crosses or irregular forms. The polyp calyces are rounded warts with a marginal fringe of long sharp spindles projecting around the oral region.

15. *Astrogorgia*, Verrill, Amer. Journ. Sci. and Arts, vol. xlv. p. 413, 1868.

The colony is branched, with irregularly distributed projecting polyp calyces, on which the spicules occur in eight longitudinal rows. There is a well-marked tentacular operculum. The spicules are small spindles with double and simple clubs.

16. *Bebryce*, Philippi, Archiv f. Naturgesch., Bd. i. p. 35, 1842; Köl liker, Icones histiologicæ, pt. ii. p. 137; v. Koch, Fauna und Flora d. Golfes v. Neapel., xv. 1887, p. 54.

The colony is branched, with a very thin cœnenchyma, and relatively high, sub-cylindrical calyces, which are alternately arranged on the axis. The spicules of the cœnenchyma form externally a layer of scales which exhibit more or less dentate or irregular margins, one or more, longer or shorter, warty processes being given off from each centre. Beneath these, there is a layer of warty irregular spindles including tri- and hexradiate forms. Spicules of the same shapes are found in the polyp calyces.

17. *Acamptogorgia*, n. gen.

*Perisceles*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. i. p. 57 (name already in use for a Coleopteron).

The colony is branched, with tubular, cylindrical, short polyp calyces, which are usually given off alternately from each side of the axis. The spicules are foliaceous clubs, the folia project beyond the cœnenchyma, but the triradiate bases are embedded in the cœnenchyma. In most cases bidentate folia, at right angles to one another, originate from a tripartite base. Besides these there are also warty curved spindles and clubs. The tentacular opercula are well developed.

18. *Thesea*, Duchassaing and Michelotti, Suppl. Mem. Corall. des Antilles, p. 12, 1864; Kölliker, Icones histiologicæ, pt. ii. p. 137.

This genus should probably be included here, as having affinities to *Acis*. The colony is upright, ramified, with a horny and calcareous axis. The polyps arise from either side of the flattened branches; they are short.

19. *Acis*, Duchassaing and Michelotti, Mem. Corall. des Antilles, p. 19, 1860; Suppl. Mem., p. 14, 1864; Kölliker, Icones histiologicæ, pt. ii. p. 136, 1865; Ridley, Ann. and Mag. Nat. Hist., ser. 5, vol. x. p. 126, 1882.

The colony is branched, the polyps are small, with wart-like verrucæ, usually placed at considerable intervals on the sides of the main stem and branches. The cœnenchyma is armed with immense spicules in the form of either smooth or warty spindles, those on the stem often reach to a length of from 1 to 3 mm. The polyp spicules are smaller scales or discs. The spicules on the basal portions of the tentacles form an operculum over the retracted polyp.

20. *Elasmogorgia*, n. gen.

*Elasma*, Wright and Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. i. p. 58 (*Elasma* having been already utilised for a reptile, *Elasmogorgia* is substituted).

A simple or slightly branched colony with thin cœnenchyma. The polyp calyces project as inconspicuous warts. The calyx margins are infolded over the tentacles when retracted, so that the latter appears to be invaginated. The spicules are warty spindles, which lie thickly in the cœnenchyma, forming a uniform layer.

21. *Muricella*, Verrill, Trans. Connect. Acad., vol. i. p. 450, 1869.

The colony is branched, with a thin cœnenchyma. The polyps are short, subconical wart-like and usually arise at right angles from their bases. The spicules of the cœnenchyma are long warty spindles; shorter forms occur in the calyces.

22. *Eumuricea*, Verrill, Trans. Connect. Acad., vol. i. p. 449, 1869.

The colony is branched, the polyps form tubular warts, exhibiting when retracted an eight-rayed figure. The spicules in the cœnenchyma and calyces are elongated sharp-pointed spindles.

23. *Muricea*, Auct. *emend.* Verrill (as subgen.), Trans. Connect. Acad., vol. i. p. 450, 1869.

The colony is branched, with a thick cœnenchyma and terminally bilobed polyp calyces markedly projecting. In the polyps when retracted the dorsal half of the calyx projects as a lip. The tentacular operculum is drawn into the calyx. The spicules are either warty spicules, which are usually short and thick, or they sometimes approximate to the club-shaped form. Besides these, long spiny spicules usually occur in the deeper layers.

#### Family IX. PLEXAURIDÆ.

*Plexauridæ*, Gray, Ann. and Mag. Nat. Hist., ser. 3, vol. iv. p. 444, 1859.

*Euniceidæ*, Kölliker, Icones histiologicæ, pt. ii. p. 137, 1859.

*Plexauridæ*, Verrill, Trans. Connect. Acad., vol. i. p. 413, 1869.

*Plexauridæ*, Klunzinger, Korallthiere des rothen Meeres, pt. i. p. 51, 1877.

The polyp colony is usually branched and upright. The axis is horny, or horny and calcareous, especially at the base. The cœnenchyma is thick. The polyps occur over the whole circumference of the cœnenchyma. The anterior tentacular and œsophageal portions of the polyps are retractile into a calyx region, forming wart-like protuberances, or they are completely retractile into the cœnenchyma. Thus, in many instances the apertures of the polyps appear as openings or simple pores in the cœnenchyma. The canalicular system consists of small reticulate canals, radiating from the polyp cavities, and opening finally into the longitudinal canals, which latter are arranged symmetrically around the axis. The spicules are usually large, of variable form; the cortical layer mostly consists of a layer of clubs, beneath which spindle-shaped spicules are found. The tentacles of the polyps are at their bases provided with spindle-shaped spicules.

Verrill's<sup>1</sup> diagnosis of this family is here reproduced; he has most tersely summed up the characteristics of the group. The genus *Eunicella* was first referred by Verrill to the Gorgonidæ, but was afterwards<sup>2</sup> rightly placed in this family. A divergent type is, however, represented by *Eunicella albicans*, Verrill, in which the flat axis recalls the structure of many Gorgonidæ.

The Plexauridæ are most nearly related to the Muriceidæ, *Eunicea* is closely related to *Muricea*, while on the other hand *Eunicella* leads on to the Gorgonidæ.

- |                                   |                                    |
|-----------------------------------|------------------------------------|
| 1. <i>Eunicea</i> , Lamouroux.    | 5. <i>Pseudoplexaura</i> , n. gen. |
| 2. <i>Plexaura</i> , Lamouroux.   | 6. <i>Euplexaura</i> , Verrill.    |
| 3. <i>Plexauroides</i> , n. gen.  | 7. <i>Psammogorgia</i> , Verrill.  |
| 4. <i>Plexaurella</i> , Kölliker. | 8. <i>Eunicella</i> , Verrill.     |
| 9. <i>Platygorgia</i> , Studer.   |                                    |

<sup>1</sup> Notes on Radiata, Trans. Connect. Acad., vol. i. p. 413.

<sup>2</sup> Amer. Journ. Sci. and Arts., vol. xlviii., 1869.

1. *Eunicea*, Lamouroux, Hist. des Polyp. flexibles, p. 431, 1816; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 146.

This genus is characterised by the polyps having prominent calyces, which usually have a projecting lip-like portion. The thick cœnenchyma has an outer cortical layer of foliaceous or spinose clubs, and an inner layer of spindles.

2. *Plexaura*, Lamouroux, Hist. des Polyp. flexibles, p. 424, 1816; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 152, 1857; Kölliker, *pro parte*, Icones histiologicæ, pt. ii. p. 138, 1865.

The genus has a horny axis, but the polyps have no projecting calyces. The cœnenchyma includes an outer cortical layer of club-shaped or spinose spicules, and an inner layer of spindles.

3. *Plexauroides*, n. gen.

The colony is branched, mostly in the one plane. The axis is horny, with a central calcareous portion. Cœnenchyma thin, outer layer of spicules foliaceous clubs, the folia of which project, forming a rough surface. There is an inner layer of irregular stellate forms. The polyps are numerous, fully retractile, the verrucæ are scarcely prominent, their edges are fringed with the projecting folia of the foliaceous clubs.

4. *Plexaurella*, Kölliker, Icones histiologicæ, pt. ii. p. 138.

This genus is distinguished from *Plexaura*, which it resembles in external habit, by the partially intercalcified axis, and by the spicules. The latter consist of tri- and tetra-radiate forms, and of simple or foliaceous clubs. The spicules show a tendency to develop twin, triple or quadruple forms. The tentacles of the polyps contain spicules extending into the pinnæ.

5. *Pseudoplexaura*, n. gen.

The colony is but feebly branched. The axis is horny, sometimes with calcareous particles interspersed. The cœnenchyma is thick, membranous, the outer layer is friable with colourless spiny spindles, the inner layer is thick with coloured stellate spicules. The polyps are numerous, arranged in a spiral manner. The polyps are completely retractile, without spicules in the tentacles.

6. *Euplexaura*, Verrill, Proc. Essex Inst., vol. vi. p. 74, 1869.

This genus resembles *Plexaurella*, and has large polyps. The polyps are numerous and completely retractile. The cœnenchyma is dense, granular. The spicules are short, blunt warty spindles of rather small size, and also small simple double-spindles and a few minute irregular crosses.

7. *Psammogorgia*, Verrill, Amer. Journ. Sci. and Arts, vol. xlv. p. 413, 1868; Trans. Connect. Acad., vol. i. p. 414, 1869.

The colony is upright and branched, with a horny axis; the cœnenchyma is moderately thick; the surface is finely granular with small rough spicules. The polyp calyces are scattered over the surface, sometimes level with it, more usually projecting in the form of roundish warts. The polyps contain large attenuated warty spindles which extend to the base of the tentacles. The spicules of the cœnenchyma are short, thick, spiny and warty spindles and also warty clubs.

8. *Eunicella*, Verrill, Amer. Journ. Sci. and Arts, vol. xlviii. p. 425, 1869.

The colony is upright, simple or branched; the polyp calyces are in the form of projecting warts. The cœnenchyma is thin or moderately thick, with small warty double spindles, but having also a layer of peculiar club-shaped spicules, which form a continuous external layer, the spicules being at right angles to the axis.

9. *Platygorgia*, Studer, Archiv f. Naturgesch., Jahrg. liii. Bd. i. p. 60.

*Muritella*, Gray (*ex parte*), Ann. and Mag. Nat. Hist., ser. 4, vol. v. p. 405.

The colony is upright and branched; the branches and the horny axis are flattened in the plane of ramification. The polyp calyces are sunk into the cœnenchyma, and do not project. There is a cortical layer of small clubs with terminal expansions, and under these are thick warty spindles. This genus is formed to include *Gorgonia albicans*, Kölliker, *Gorgonia palma*, var. *alba*, Esper. The retracted polyps and the flattened branches present an appearance so different from that of the type species of *Eunicella*, that a generic separation appears to be warranted. The spicules are also characteristic, since the clubs are here as long as the spindles. *Muritella*, Gray, included *Gorgonia albicans*, Kölliker = *Gorgonia palma*, Pallas, and *Gorgonia fucosa*, Valenciennes.

## Family X. GORGONIDÆ.

*Gorgonidæ*, Dana (*pro parte*), Zoophytes, p. 651.

*Gorgoniaceæ*, Milne-Edwards (*pro parte*), Hist. Nat. des Coralliaires, t. i. p. 144.

*Gorgoniaceæ*, Kölliker (*pro parte*), Icones histiologicæ, pt. ii. p. 139.

*Gorgonidæ*, Verrill, Trans. Connect. Acad., vol. i. p. 386, and footnote (reprint), 1869.

The colonies are upright and branched, usually in one plane. The axis is horny, rarely horny and calcareous. The polyps arise from the stem and twigs in a bilateral or biradiate manner, and a corresponding symmetry may also be observed in the canalicular system. The anterior portion of each polyp is retractile either into projecting calyces or into the cœnenchyma. The latter has externally a smooth appearance. The spicules are small, predominantly spindle-shaped, and are not disposed in two layers.

Kölliker<sup>1</sup> was the first to employ characters drawn from the spicules for the revision of the numerous genera into which Milne-Edwards had divided up the old genus *Gorgonia*, Auct. He showed that among the species of the genera *Leptogorgia*, *Lophogorgia*, *Pterogorgia*, *Xiphigorgia*, *Rhipidogorgia*, *Hymenogorgia*, *Phyllogorgia*, *Phycogorgia*, and in part *Gorgonia*, many exhibited in regard to their spicules a great resemblance, but that others, *e.g.*, some species of *Pterogorgia*, *Leptogorgia*, and *Rhipidogorgia*, showed such dissimilarity that they had to be referred even to distinct families. The allied species he united into a single genus, for which he retained the old name *Gorgonia*, of which, according to the form of the spicules, Kölliker distinguished three divisions. First, those which had only spindles; second, those which had both spindle-shaped and scaphoid spicules; third, those which have spindles, and in addition a special cortical layer of clubs.

Verrill<sup>2</sup> agrees generally with the conclusions of Kölliker, but differs in distinguishing the three divisions as so many independent genera. For the first division, the species of which are spindles only, the name *Litigorgia*, afterwards that of *Leptogorgia*, was proposed; for the second, with spindles and scaphoids, the name *Pterogorgia*, and subsequently *Gorgonia* was proposed; while for the third division, the name *Gorgonia*, and subsequently *Eunicella*, was given. To these three there was added a fourth genus (*Eugorgia*), in which the spicules were double spindles and double wheels. In the memoir cited it was shown by Verrill that *Eunicella* should be placed in nearer relationship with the Plexauridæ, and to this family Verrill subsequently<sup>3</sup> referred the genus. However natural and easily understood is such a distinction of genera, yet this subdivision of this family can be based on other characters in addition to the form of the spicules.

Among the Gorgonidæ one may observe in the disposition of the polyps a tendency towards a biradial arrangement. The same thing is indicated even in the form of the

<sup>1</sup> Icones histiologicæ, pt. ii. p. 139.

<sup>2</sup> Notes on Radiata, Trans. Connect. Acad., vol. i. p. 384.

<sup>3</sup> Amer. Journ. Sci. and Arts, vol. xlviii. p. 425, 1869.



colony, which is ramified in one plane. The horny axes are frequently flattened in the same plane, and the cœnenchyma is also compressed. Thus the stem and branches show in section two flattened surfaces and two edges. The polyps are ranged chiefly on the edges of the axis, and, in some cases, they occupy it alone, but in rare cases they are found massed on the flattened surfaces (*Hymenogorgia*). The system of longitudinal canals shows the same tendency. The longitudinal canals vary in width according to their position on the axis. Through the lateral position of the polyps, the longitudinal canals, which run along the surface of the axis, are very few in number, as in the smaller species of *Leptogorgia*, in which,—as, for example, in *Leptogorgia arbuscula*, Verr.—only one large longitudinal canal runs along the flattened side of the axis. The course of the larger longitudinal canals is often indicated externally by one or more ridges or furrows on the cœnenchyma. In some cases the larger longitudinal canals run along the edges of the compressed axes, while smaller ones course down their flattened surfaces. This is the case in *Gorgonia anceps*, Pall., for which, therefore, the generic name *Xiphigorgia*, Milne-Edwards, is retained. *Swiftia*, Duchassaing and Michelotti, appears to belong to the Gorgonidæ, though in their Memoir on the Corals of the Antilles these authors place it among the Primnoidæ.

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|--|---|
| 1. <i>Platycaulos</i> , n. gen.                      | 7. <i>Gorgonia</i> , Linneus, <i>emend.</i> |
| 2. <i>Lophogorgia</i> , Milne-Edwards.               | Verrill.                                    |
| 3. <i>Leptogorgia</i> , Milne-Edwards, <i>emend.</i> | 8. <i>Eugorgia</i> , Verrill.               |
| Verrill.   | 9. <i>Danielssenia</i> , Grieg.             |
| 4. <i>Stenogorgia</i> , Verrill.                     | 10. <i>Xiphigorgia</i> , Milne-Edwards.     |
| 5. <i>Callistephanus</i> , n. gen.                   | 11. <i>Hymenogorgia</i> , Valenciennes.     |
| 6. <i>Swiftia</i> , Duchassaing and Michelotti.      | 12. <i>Phycogorgia</i> , Valenciennes.      |

1. *Platycaulos*, n. gen.

The colony is branched in one plane, the branches sometimes anastomosing. The axis is horny, compressed, with a calcareous centre and calcareous particles interspersed. The nutrient canals are symmetrical. Polyps prominent on edges of the stem and branches, retractile within verrucæ. The cœnenchyma is moderate, tough, the spicules, straight and curved, spiny spindles and stellate forms.

2. *Lophogorgia*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 167.

*Gorgonia*, Kölliker (*pars*), Icones histiologicæ, pt. ii. p. 139.

*Leptogorgia*, Verrill (*pars*), Amer. Journ. Sci. and Arts, vol. xlviii. p. 425.

The colony is upright, branched in one plane, with flattened stem and branches; the terminal twigs assume a cylindrical form. The polyps are sunk into the cœnenchyma without forming true verrucæ.

On the terminal twigs the polyps are distributed over the whole periphery; on the larger branches they are ranged more laterally. The larger longitudinal vessels are distributed over the flattened portions of the axis but are placed peripherally on the cylindrical twigs. The spicules are warty and needle-shaped spindles.

In general habit and in the nature of the cœnenchyma this genus is closely allied to the former one, but it differs considerably in the nature of the spicules. *Gorgonia flummea*, Ellis and Solander, and *Lophogorgia cristata*, Möbius, are representative forms.

3. *Leptogorgia*, Milne-Edwards, *emend.* Verrill. Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 163 (*ex parte*); *emend.* Verrill, Trans. Connect. Acad., vol. i. p. 387.

The colony varies greatly in form, but is more or less ramified in one plane. It often exhibits a net-like structure from an anastomosis of the branches. The polyps sometimes form short verrucæ, and sometimes are completely retracted into the cœnenchyma. They are usually disposed in two lateral rows, having between them the naked cœnenchyma. Upon the surface of the latter the courses of the larger tubes are indicated by longitudinal depressions.

The spicules are usually minute double spindles of variable length.

4. *Stenogorgia*, Verrill, Bull. Mus. Comp. Zoöl., vol. xi. p. 29, No. 1, 1883.

The colony is branched, axis horny. Cœnenchyma thin, with small warty spindle-shaped spicules, and on the surface a few smaller, short, irregular, rough, granular spicules, which do not form a complete layer. The polyps are scattered or disposed in two rows; they project from the surface. The polyp spicules are like those of the cœnenchyma, but in the tentacles spindle-shaped spicules occur. The polyps are retractile and are bent inwards when at rest.

5. *Callistephanus*, n. gen.

The colony is feebly branched, branches arising in the one plane at right angles, axis horny and calcareous. Polyps very prominent, retractile within dome-like verrucæ, arising for the most part from the sides of the stem and branches. The cœnenchyma is thick, granular. The spicules of the cœnenchyma are spiny spindles, clubs, and half-sided warty clubs. At the base of the polyps the spicules are needle-shaped.

6. *Swiftia*, Duchassaing and Michelotti, Suppl. Mem. Corall. des Antilles, 1864, p. 13.

The colony is upright, ramified with a horny, calcareous axis (?). Polyps at either side of the branches, within verrucæ. The tentacles have spindle-shaped spicules, and the spicules of the cœnenchyma are scales.

7. *Gorgonia*, Linneus, *emend.* Verrill, Amer. Journ. Sci. and Arts, vol. xlviii. p. 424, 1869.

*Rhipidogorgia (pars)*, Verrill, *loc. cit.*

*Pterogorgia*, Verrill, Trans. Connect. Acad., vol. i. p. 386, 1869.

The colony is branched, but varies greatly in form, sometimes with anastomosing branches, sometimes plume-shaped. The polyps project more or less, and are disposed in two rows on either side of the branches and twigs. The cœnenchyma contains spindles and scaphoid spicules.

8. *Eugorgia*, Verrill, Amer. Journ. Sci. and Arts, vol. xlv. p. 414, 1868; Trans. Connect. Acad., vol. i. p. 406, 1869.

The colonies are branched, branches compressed or cylindrical. The polyps with or without verrucæ. They are chiefly grouped on either side of the branches. In the cœnenchyma there are minute, warty, double spindles and double wheels; in the calyces there are small, slender spicules.

9. *Danielssenia*, Grieg, Bergens Museums Aarsberetning for 1886; Bidrag til de Norske Alcyonariumer, p. 8, pl. iii. fig. 33, iv. vi.

Colony unbranched; base adherent; axis horny, cylindrical. Polyps in a single row on both sides of the stem; polyps with low, broad enlarged bases. Cœnenchyma somewhat thick; spicules, spindles, clubs and double stars.

10. *Xiphigorgia*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 171.

*Gorgonia*, Div. E, Verrill, Amer. Journ. Sci. and Arts, vol. xlviii. p. 425.

The colony is more or less ramified; the axis is horny; the stem is cylindrical, but the branches are much compressed, forming at either edge small wing-like longitudinal ridges, which are formed from the cœnenchyma and bear the polyp openings disposed in rows. The smaller longitudinal canals run peripherally along the axis; a large, broad canal lies within each of the wing-like expansions. The spicules are like those in *Gorgonia*.

11. *Hymenogorgia*, Valenciennes, Comptes rendus, t. xli. p. 13; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 181.

Incl. *Phyllogorgia*, Milne Edw. and Haime, Brit. Foss. Corals, Introd., pl. lxxx., 1850; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 180.

*Gorgonia*, Div. F and G, Verrill, Amer. Journ. Sci. and Arts, vol. xlviii. p. 425.

An upright colony with a horny axis ramified in one plane. The branches some-

times coalesce and sometimes are free. The cœnenchyma forms a continuous sheath over the whole axis and its ramifications, so that the colony has a leaf-like appearance. The polyps are scattered over the face of the expanded folia, not seated on their edges.

The longitudinal canals follow in the course of the ramifications of the axis, while the polyps in the leaf-like cœnenchymatous extension communicate with each other by a reticulated canal-system, which finally opens into the longitudinal canals.

12. *Phycogorgia*, Valenciennes, Comptes rendus, t. xli. p. 13; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 182; Verrill, Trans. Connect. Acad., vol. xlviii. p. 413.

The colony is ramified, with a horny axis dividing into a number of thin leaf-like expansions, which are covered with a thin cœnenchyma. The polyp openings are sunk within the cœnenchyma.

#### Family XI. GORGONELLIDÆ.

*Gorgonellaceæ*, Valenciennes, Comptes rendus, t. xli. p. 14; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 182; Kölliker (*pars*), Icones histologicæ, pt. ii. p. 140.  
*Elliselladæ*, *Calligorgiadæ* (*pars*), Gray, Cat. Lithophytes Brit. Mus., pp. 24, 34.

In the species of this family the cœnenchyma is thin, smooth on the surface, with small spicules in the form of warty double-clubs and stellate forms. The polyps have more or less well-developed verrucæ, and are usually biradially disposed. The axis is lamellar and calcareous, but retains its shape after the extraction of the calcareous matter.

The family Gorgonellidæ is here accepted as diagnosed by Kölliker, the genus *Herophila*, Steenstrup (*Riisea*, D. and M.), being, however, excluded.

The colonies in Gorgonellidæ form simple or branched masses whose calcareous axis gives to the whole a rigid appearance. The branches and twigs are frequently flattened and the polyps are either distributed in two rows on the edges thereof, or are so disposed in lateral bands that a free space is left in the middle, in which are to be found one or more longitudinal furrows. The longitudinal canals are partly of small diameter, partly large. Two usually occur on the surfaces of the stem which are destitute of polyps. On the surface of the cœnenchyma in dried specimens their position is marked by longitudinal grooves.

Gray divided this family into a large number of genera and arranged these in subfamilies. The majority he included within his family Elliselladæ, while others, *Nicella* and *Scirpearia*, are referred by him to the entirely heterogeneous family of the Calligorgiadæ. The genus *Hypnogorgia*, Duch. and Mich., which Gray refers to the Elliselladæ, is most probably a Muriceid, as seems apparent from the representation<sup>1</sup> and

<sup>1</sup> Suppl. Coral. des Antilles, pl. v. p. 1.

the remark of the authors that it is nearly related to *Blepharogorgia* = *Acanthogorgia*. Similarly *Brandella intricata*, Gray, is a Muriceid, and *Wrightella*, Gray, belongs to the Melitodidæ.

The following genera have been as yet distinguished :—

- |   |   |
|---|---|
| 1. <i>Nicella</i> , Gray.                                   | 5. <i>Ellisella</i> , Gray, <i>emend.</i> Studer. |
| 2. <i>Scirpearia</i> , Cuvier, <i>emend.</i> Studer.        | 6. <i>Verrucella</i> , Milne-Edwards.             |
| 3. <i>Scirpearella</i> , n. gen.                            | 7. <i>Gorgonella</i> , Milne-Edwards.             |
| 4. <i>Juncella</i> , Valenciennes, <i>emend.</i><br>Studer. | 8. <i>Ctenocella</i> , Valenciennes.              |
|   | 9. <i>Phenilia</i> , Gray.                        |
| 10. <i>Heliana</i> , Gray.                                  |   |

1. *Nicella*, Gray, Cat. Lithophytes Brit. Mus., p. 40.

The colony is upright, branched, with a thin cœnenchyma and protruding verrucæ, which arise perpendicularly and appear to be terminally truncated. The polyps arise from either side of the stem and branches leaving a middle space free. The spicules form a cortical layer of small double clubs and an internal layer of long, densely warty spindles.

2. *Scirpearia*, Cuvier, Règne Anim., Nouv. Éd., t. iii. p. 319, 1830.

The colony is simple, with a cylindrical calcified axis and thin cœnenchyma. The polyps are seated in two longitudinal rows on each side of the stem. The spicules are double clubs and spindles. The genus may include *Scirpearia mirabilis*, Cuvier, and *Viminella flagellum*, Gray.

3. *Scirpearella*, n. gen.

Colony simple or very feebly branched. Axis calcareous, brittle, smooth or grooved. Polyps arranged in rows or spirals, retractile with rather more or less prominent verrucæ. The cœnenchyma is moderately thick and finely granular. The spicules are spiny spindles and double clubs.

4. *Juncella*, Valenciennes, *ex parte*, Comptes rendus, t. xli. p. 14; Kölliker, Icones histiologicæ, pt. ii. p. 140; Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 659, 1878.

The colony is simple or branched, the polyps are sometimes small, disposed in two lateral rows, sometimes with well-developed and elongated verrucæ. The cœnenchyma is thick, with an external layer which contains simple and double clubs.

5. *Ellisella*, Gray, Proc. Zool. Soc. Lond., p. 257, 1857; Cat. Lithophytes Brit. Mus., p. 25, 1870; *emend.* Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 659, 1878.

The colony is simple or dichotomously branched, with a thick cœnenchyma, and slightly developed verrucæ, which are disposed in two rows on the axis. The cœnenchyma contains both double clubs and spindles.

6. *Verrucella*, Milne-Edwards (*pars*), Hist. Nat. des Coralliaires, t. i. p. 184; Kölliker, Icones histiologicæ, pt. ii. p. 140; Duchassaing and Michelotti, Mem. Corall. des Antilles, p. 33, Suppl. p. 114.

The colony is branched. The axis is lamellar and calcified. The verrucæ are wart-like, on the summits of which the bases of the polyp tentacles form an eight-rayed star-like operculum. The spicules of the cœnenchyma are beset with roundish and conical simple warts, there are also double stars, with transitions to double spindles and simple spindles, and there are also minute spiny double stars.

7. *Gorgonella*, Valenciennes (*pars*), Comptes rendus, t. xli. p. 14; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 183, 1857; Valenciennes (*pars*), Kölliker, Icones histiologicæ, pt. ii. p. 139.

The colony is much branched, in one plane, often forming a network by the anastomosis of the branches. The verrucæ are inconspicuous, wart-like, disposed on two sides of the branches. The axis is lamellar, and radially striated. The cœnenchyma includes warty double spheres and double spindles.

8. *Ctenocella*, Valenciennes, Comptes rendus, t. xli. p. 14; Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 185; Ridley, Rep. Zool. Coll. H.M.S. "Alert," p. 348.

The colony is branched in one plane; and so as that all the simple twigs arise in an ascending order from the upper surface of the stem. The verrucæ are short on two sides of the twigs. There are distinct median furrows. The spicules are warty double-clubs; those of the polyp calyces are, according to Ridley, somewhat different from those of the cœnenchyma, being longer and provided with two, often three whorls of tubercles. The inner whorls so approach in the middle of the spicules, that the median naked zone which is characteristic of the spicules of the cœnenchyma, is here absent.

9. *Phenilia*, Gray, Proc. Zool. Soc. Lond., 1859, p. 482; Cat. Lithophytes Brit. Mus., 1870, p. 32.

According to Gray's diagnosis the colony is branched and tree-like, with short, divergent, approximately quadrangular branches which sometimes anastomose. The polyp calyces are short, and disposed in two or three irregular rows on each side of the branches. The cœnenchyma is granular; lateral grooves are distinct. Spicules like those of *Gorgonella*.

10. *Heliana*, Gray, Proc. Zool. Soc. Lond., 1859, p. 480; Cat. Lithophytes Brit. Mus., 1870, p. 32.

According to Gray's diagnosis the colony is tree-like, dichotomously branched. The twigs are upright and divergent. The lower twigs sometimes anastomose. The cœnenchyma is hard and granular. The calyces project and are subcylindrical in form, short, rather curved. They occur in two, three, or four alternating rows on the sides of the twigs, and irregularly on the branches. The axis is hard, calcareous greyish-brown. Spicules (?).





# TABLE OF FAMILIES AND GENERA.

## ALCYONARIA, Milne-Edwards.

### Order I. ALCYONACEA, Verrill.

#### Family I. HAIMEIDÆ.

1. *Haimea*, Milne-Edwards.
2. *Hartea*, Perceval Wright.
3. *Monozenia*, Haeckel.

#### Family II. CORNULARIADÆ, Dana.

1. *Cornularia*, Lamarck.
2. *Rhizozenia*, Ehrenberg.
3. *Clavularia*, Quoy and Gaimard.
4. *Sarcodictyon*, Forbes.
5. *Anthelia*, Savigny.
6. *Gymnosarca*, Saville Kent.
7. *Cornulariella*, Verrill.
8. *Telesto*, Lamouroux.
9. *Cœlogorgia*, Milne-Edwards.
10. *Cyathopodium*, Verrill.
11. *Scleranthelia*, Studer.
12. *Anthopodium*, Verrill.
13. *Sympodium*, Ehrenberg.
14. *Erythropodium*, Kolliker.
15. *Callipodium*, Verrill.
16. *Pseudogorgia*, Kolliker.

#### Family III. TUBIPORIDÆ.

1. *Tubipora*, Linneus.

#### Family IV. XENIDÆ.

1. *Xenia*, Savigny.

#### Family V. ORGANIDÆ, Danielssen.

1. *Organidus*, Danielssen.

#### Family VI. ALCYONIDÆ, Verrill.

1. *Crystallophanes*, Danielssen.
2. *Bellonella*, Gray.
3. *Nidalia*, Gray.
4. *Paralcyonium*, Milne-Edwards.
5. *Sarakka*, Danielssen.
6. *Alcyonium*, Linneus.
7. *Lobularia*, Savigny.
8. *Sarcophytum*, Lesson.
9. *Lobophytum*, Marenzeller.
10. *Anthomastus*, Verrill.
11. *Nannodendron*, Danielssen.

#### Family VII. NEPHTHYIDÆ.

##### Subfamily SPONGODINÆ.

1. *Væringia*, Danielssen.
2. *Fulla*, Danielssen.
3. *Barathrobius*, Danielssen.
4. *Gersemia*, Marenzeller.
5. *Gersemiopsis*, Danielssen.
6. *Drifa*, Danielssen.
7. *Dura*, Koren and Danielssen.
8. *Eunephthya*, Verrill.
9. *Ammothea*, Savigny.
10. *Nephthya*, Savigny.
11. *Spongodes*, Lesson.

##### Subfamily SIPHONOGORGINÆ.

12. *Paranephthya*, n. gen.
13. *Scleronephthya*, n. gen.
14. *Chironephthya*, n. gen.
15. *Siphonogorgia*, Kolliker.

#### Family VIII. HELIOPORIDÆ.

1. *Heliopora*, Blainville.

## Order II. PENNATULACEA, Verrill.

## Section I. PENNATULACEA.

## Subsection I. Penniformes.

## Family I. PTEROEIDIDÆ.

1. *Pteroeides*, Herklots.
2. *Godefroyia*, Kölliker.
3. *Sarcophyllum*, Kölliker.

## Family II. PENNATULIDÆ.

1. *Pennatula*, Lamarck.
2. *Sciophyllum*, Verrill.
3. *Ptilosarcus*, Gray.
4. *Halisceptrum*, Herklots.

## Subsection II. Virgulariæ.

## Family III. VIRGULARIDÆ.

1. *Virgularia*, Lamarck.
2. *Scytalum*, Herklots.
3. *Pavonaria*, Kölliker.

## Family IV. STYLATULIDÆ.

1. *Stylatula*, Verrill.
2. *Suava*, Danielssen and Koren.
3. *Dubenia*, Danielssen and Koren.
4. *Acanthoptilum*, Kölliker.

## Section II. SPICATÆ.

## Subsection I. Funiculinæ.

## Family I. FUNICULINIDÆ.

1. *Funiculus*, Lamarck.
2. *Halipterus*, Kölliker.

## Family II. STACHYPTILIDÆ.

1. *Stachyptilum*, Kölliker.

## Family III. ANTHOPTILIDÆ.

1. *Anthoptilum*, Kölliker.

## Subsection II. Junciformes.

## Family IV. KOPHOBELEMNONIDÆ.

1. *Kophobelemnion*, Asbjornsen.
2. *Sclerobelemnion*, Kölliker.
3. *Bathyptilum*, Kölliker.

## Family V. UMBELLULIDÆ.

1. *Umbellula*, Lamarck.

## Family VI. PROTOCAULIDÆ.

1. *Protocaulon*, Kölliker.
2. *Cladiscus*, Koren and Danielssen.

## Family VII. PROTOPTILIDÆ.

1. *Protoptilum*, Kölliker.
2. *Lygomorpha*, Koren and Danielssen.
3. *Microptilum*, Kölliker.
4. *Leptoptilum*, Kölliker.
5. *Trichoptilum*, Kölliker.
6. *Scleroptilum*, Kölliker.
7. *Distichoptilum*, Verrill.
8. *Gunneria*, Danielssen and Koren.

## Section III. RENILLEÆ.

## Family I. RENILLIDÆ.

1. *Renilla*, Lamarck.

## Section IV. VERETILLEÆ.

## Family I. CAVERNULARIDÆ.

1. *Cavernularia*, Valenciennes.
2. *Styloblemnion*, Kölliker.

## Family II. LITULARIDÆ.

1. *Litularia*, Valenciennes.
2. *Veretillum*, Cuvier.
3. *Policella*, Gray.
4. *Clavella*, Gray.

## Section V. GOENDULEA, Koren and Danielssen.

## Family I. GOENDULIDÆ.

1. *Goendul*, Koren and Danielssen.

## Order III. GORGONACEA, Verrill.

## Section I. SCLERAXONIA.

## Family I. BRIAREIDÆ.

## Subfamily BRIAREINÆ.

1. *Leucoella*, Gray.
2. *Solenocaulon*, Gray.
3. *Semperina*, Kölliker.
4. *Suberia*, Studer.
5. *Anthothela*, Verrill.
6. *Paragorgia*, Milne-Edwards.
7. *Briareum*, Pallas.

## Subfamily SPONGIODERMINÆ.

8. *Titunideum*, Agassiz.
9. *Iciligorgia*, Ridley.
10. *Spongioderma*, Kölliker.

## Family II. SCLEROGORGIA.

1. *Suberogorgia*, Gray.
2. *Keroeides*, n. gen.

## Family III. MELITODIDÆ.

1. *Melitodes*, Verrill.
2. *Mopsella*, Gray.
3. *Acaburia*, Gray.
4. *Psilacabaria*, Ridley.
5. *Wrightella*, Gray.
6. *Clathraria*, Gray.
7. *Parisis*, Verrill.

## Family IV. CORALLIDÆ.

1. *Corallium*, Lamareck.
2. *Pleurocorallium*, Gray.

## Section II. HOLAXONIA.

## Family V. DASYGORGIDÆ.

## Subfamily STROPHOGORGINÆ.

1. *Strophogorgia*, Perceval Wright.

## Subfamily CHRYSOGORGINÆ.

2. *Chrysogorgia*, Duchassaing and Michelotti.
3. *Herophile*, Steenstrup.
4. *Dasygorgia*, Verrill.
5. *Iridogorgia*, Verrill.

## Family VI. ISIDÆ.

## Subfamily CERATOISIDINÆ.

1. *Bathygorgia*, Perceval Wright.
2. *Ceratoisis*, Perceval Wright.
3. *Callisis*, Verrill.
4. *Acanella*, Gray.
5. *Isidella*, Gray.
6. *Sclerisis*, Studer.

## Subfamily MOPSEINÆ.

7. *Primnoisis*, n. gen.
8. *Mopsea*, Lamouroux.
9. *Acanthoisis*, n. gen.

## Subfamily ISIDINÆ, Kölliker.

10. *Isis*, Linneus.

## Family VII. PRIMNOIDÆ.

## Subfamily CALLOZOSTRINÆ.

1. *Callozostrom*, Perceval Wright.

## Subfamily CALYPTROPHORINÆ.

2. *Calyptrophora*, Gray.

## Subfamily PRIMNOINÆ.

3. *Primnoa*, Lamouroux.
4. *Stachyodes*, n. gen.
5. *Calypterinus*, n. gen.
6. *Stenella*, Gray.
7. *Thouarella*, Gray.
8. *Amphilaphis*, n. gen.
9. *Plumarella*, Gray.
10. *Primnoella*, Gray.
11. *Caligorgia*, Gray.

## Subfamily PRIMNOIDINÆ.

12. *Primnoides*, n. gen.

## Family VIII. MURICEIDÆ.

1. *Acanthogorgia*, Gray.
2. *Muriceides*, n. gen.
3. *Hypnogorgia*, Duchassaing and Michelotti.
4. *Paramuricea*, Kölliker.
5. *Anthomuricea*, n. gen.
6. *Clematissa*, n. gen.
7. *Villogorgia*, Duchassaing and Michelotti.
8. *Anthogorgia*, Verrill.
9. *Menella*, Gray.
10. *Placogorgia*, n. gen.
11. *Echinomuricea*, Verrill.
12. *Echinogorgia*, Kölliker.
13. *Menacella*, Gray.
14. *Heterogorgia*, Verrill.
15. *Astrogorgia*, Verrill.
16. *Bebryce*, Phillipi.
17. *Acamptogorgia*, n. gen.
18. *Thesea*, Duchassaing and Michelotti.
19. *Acis*, Duchassaing and Michelotti.
20. *Elasmogorgia*, n. gen.
21. *Muricella*, Verrill.
22. *Eumuricea*, Verrill.
23. *Muricea*, Verrill.

## Family IX. PLESAURIDÆ.

1. *Eunicea*, Lamouroux.
2. *Plesaura*, Lamouroux.
3. *Plesauroides*, n. gen.
4. *Plexaurella*, Kölliker.
5. *Pseudoplexaura*, n. gen.
6. *Euplexaura*, Verrill.
7. *Psammogorgia*, Verrill.
8. *Eunicella*, Verrill.
9. *Platygygia*, Studer.

Family X. GORGONIDÆ.

1. *Platycaulos*, n. gen.
2. *Lophogorgia*, Milne-Edwards.
3. *Leptogorgia*, Milne-Edwards.
4. *Stenogorgia*, Verrill.
5. *Callistephanus*, n. gen.
6. *Swiftia*, Duchassaing and Michelotti.
7. *Gorgonia*, Auct., *emend.* Verrill.
8. *Eugorgia*, Verrill.
9. *Danielssenia*, Grieg.
10. *Xiphigorgia*, Milne-Edwards.
11. *Hymenogorgia*, Valenciennes.
12. *Phycogorgia*, Valenciennes.

Family XI. GORGONELLIDÆ, Verrill.

1. *Nicella*, Gray.
2. *Scirpearia*, Cuvier, *emend.* Studer.
3. *Scirpearella*, n. gen.
4. *Juncella*, Valenciennes, *emend.* Studer.
5. *Ellisella*, Gray, *emend.* Studer.
6. *Verrucella*, Milne-Edwards.
7. *Gorgonella*, Milne-Edwards.
8. *Otenocella*, Valenciennes.
9. *Phenilia*, Gray.
10. *Heliana*, Gray.

## DESCRIPTION OF GENERA AND SPECIES.

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### ALCYONARIA.

#### Order I. GORGONACEA.

##### Section I. HOLAXONIA.

##### Family I. DASYGORGIDÆ.

*Chrysogorgidæ*, Verrill, Bull. Mus. Comp. Zool., vol. xi. No. 1, p. 21, 1883.

This family is established for the genera included by Verrill in his family *Chrysogorgidæ*, as well as for a new genus of simple forms, with unbranched stems.

The genus *Chrysogorgia*, Duchassaing and Michelotti, was placed by the authors of the Memoir on the Corals of the Antilles, in their *Revue des Zoophytes, &c.* (Paris, 1871), among the Gorgonellaceæ, next to *Verrucella*, and they mention that the species described in the Supplement (p. 13) to their Memoir under the same name, but there placed among the Primnoids, is the same as that described on p. 21 of the work. The figures on pls. i. and iv. of the work of these authors, described as *Chrysogorgia desbonni*, do not appear to belong to the same species, and as the type specimen is no longer to be found in the Museum of Turin, this doubt will not be easily settled. Verrill has, however (*loc. cit.*), given a new diagnosis of the genus and also re-described *Chrysogorgia desbonni*, referring also to this genus, as a new species (*Chrysogorgia fewkesi*), a form referred to as *Chrysogorgia desbonni* by Pourtalès, in which the polyps are "covered with scales like those of the stem [irregular, not imbricated] and closed by eight blunt lancet-shaped scales."

In the uncertainty as to what species was really described by Duchassaing and Michelotti under the name *Chrysogorgia desbonni*, we prefer to adopt Verrill's genus *Dasygorgia*, which appears to be the most prominent one of the group, as the type genus of a family, which may be characterised as follows:—

Colony consisting of a simple or branched axis. Main axis; calcareous at its base, which latter is either flattened and disc-like, or ramifying into numerous root-like processes; the fibrous portions of the stems and branches with calcareous particles intermixed; often brilliantly iridescent. Coenenchyma; for the most part thin, sometimes

without spicules, at other times with numerous transparent glassy, fusiform, often spiny spicules, or with irregular scale-like spicules; sometimes the spicules are in two layers. Polyps; large, prominent, inserted on the axis either at right angles or obliquely; covered with spicules, variously arranged; tentacles retractile, sometimes only imperfectly so.

1. Strophogorginæ.—Simple unbranched axis.
2. Chrysogorginæ.—Branched axis.

#### Subfamily 1. STROPHOGORGINÆ.

Colony unbranched. The axis consists of a simple, calcareous, often brittle stem, springing from a number of root-like processes; sometimes erect, rigid, round; sometimes trailing. The cœnenchyma; in some extremely thin, allowing the iridescent axis to be seen through it, and furnished with few spicules; at other times it is thick and membranous, with numerous spicules. Polyps; prominent and arranged in a uniserial manner on the axis. The tentacles are retractile, forming by their basal portions quasi-opercular coverings. The polyp bodies are covered with spicules, which are often arranged towards the apices of the polyps in eight rows, eventually becoming smaller and then being lost on the extremities of the dorsal surface of the tentacles.

The spicules are translucent glass-like spindles or scales of irregular form; the spindles are sometimes smooth; sometimes with roughened edges.

#### Genus *Strophogorgia*,<sup>1</sup> Perceval Wright.

*Strophogorgia*, Perceval Wright, Narr. Chall. Exp., vol. i. pt. ii. p. 691, 1885.

Colony unbranched; axis calcareous, erect or creeping; iridescent. Base where observed, calcareous, divided into diverging hard and brittle root-like structures for anchoring the colony in the mud.

The polyps are prominent and arranged in a uniserial manner on the axis, either stalked or sessile. The cœnenchyma varies in thickness, being sometimes very thin, with few spicules; or membranous, with numerous spicules.

Four species are found in the collection.

1. *Strophogorgia petersi*, n. sp. (Pl. II. figs. 1, 1a; Pl. VA. fig. 1).

Colony simple, unbranched. Axis calcareous, brittle, in some specimens exceeding 6 dm. in length; the basal portions with numerous, broad, rhizome-like processes, from 3 mm. in diameter at the base to less than 1 mm. at their apices.

<sup>1</sup> στρόφος, Γοργώ.

Cœnenchyma rather thick, with numerous spicules ; polyps crowded together, but in a uniserial manner on the axis ; each polyp somewhat overlapping the one in front of it. When the tentacles are retracted the polyps measure from 5 to 6 mm. in height. Spicules on the polyp bodies, large, spindle-shaped ; those at the base of each tentacle are small, and are arranged in eight rows, so that when the tentacles are retracted they form an opercular covering over the oral cavity ; some of the larger spicules are bent, rough at the ends, or have the ends prolonged into irregular projections.

The spicules measure 1·5–0·13 ; 0·75–0·13 ; 0·53–0·12 ; 0·35–0·12 ; 0·25–0·04 ; 0·54–0·13 ; 0·75–0·02 mm. (these latter are to be found in the tentacles).

*Habitat*.—Station 232, Yedo ; May 12, 1875 ; depth, 345 fathoms ; bottom, green mud.

2. *Strophogorgia verrilli*, Perceval Wright (Pl. I. figs. 2, 2a ; Pl. VA. fig. 3).

*Strophogorgia verrilli*, Perceval Wright, Narr. Chall. Exp., vol. i. pt. ii. p. 691, 1885.

Colony unbranched. Axis calcareous, thin, hair-like. The only specimens found are without their basal attachments, and are about 18 cm. in length. The cœnenchyma on the axis is thick ; the spicules composing it are arranged side by side, and are intercalated with one another. The polyps are arranged in a uniserial manner on the axis, and measure about 3·5 mm. in height by 1 mm. in width ; the body portion of each polyp is covered with broad, spindle-shaped spicules, which are larger and denser on the portion of the body nearer the axis ; at the base of the tentacles, and extending for a little way down the body of the polyp, the spicules are arranged in eight rows, which on the tentacles being inverted, become folded over the oral cavity and form an eight-rayed quasi-operculum ; the large spicules are irregular in outline, often dentate at one or both ends.

The polyps are placed on the stem, at distances of about 6 mm. apart.

Some of the largest of the spicules measure 2 mm. in length by 0·25 mm. in breadth, others 0·99–0·12 ; 1–0·16 ; (at broad extremities) 1 and 1–0·12 ; (in middle) 0·56–0·08 ; 0·54–0·08 ; 0·58–0·1 mm.

*Habitat*.—Station 235, Japan ; depth, 565 fathoms ; bottom, green mud.

Station 237, Japan ; depth, 1875 fathoms ; bottom, blue mud.

3. *Strophogorgia challengerii*, Perceval Wright (Pl. I. figs. 1, 1a ; Pl. VA. fig. 2).

*Strophogorgia challengerii*, Perceval Wright, Narr. Chall. Exp. vol. i. pt. ii. p. 691, 1885.

The colony is unbranched, erect, calcareous, long and flexible, with an average height of about 45 cm. The axis is extremely brittle, highly iridescent ; about 1 mm. in diameter ; base with several thin, rhizome-like processes. The cœnenchyma of the axis is extremely thin, with scarcely a trace of spicules ; letting the stem be seen easily

through it. The polyps are placed on the stem in a uniserial manner; about 4 mm. apart; the axis is slightly swollen at the places where the polyps are attached; the tentacles are retractile. On the lower portion of the polyp body the spicules are few in number, but gradually towards the upper portion of the body these are arranged in eight rows, which when the polyp is contracted cover over the oral region and form an imperfect, conical operculum. Numerous specimens of this interesting species were found in the one haul of the dredge off Cadiz. The spicules are the smallest in all the known species. They are either narrow spindles, or of an oblong stellate form with a few lenticular-shaped ones on the tentacles.

Spicule measurements, 0.3–0.03; 0.3–0.025; 0.1–0.03; 0.075–0.02 mm.

*Habitat*.—Station IV., January 16, 1873; below Cadiz; depth, 600 fathoms; bottom, blue mud.

4. *Strophogorgia fragilis*, n. sp. (Pl. II. fig. 2; Pl. VA. fig. 4).

In this species, which might perhaps be referred to a new genus, the axis seems to have formed a creeping stolon, embedded in the mud; it is unbranched, very feebly calcareous. The cœnenchyma on the axis is very thin, almost without spicules.

The polyps are large, elongate, arranged in a single row on the stem; about 1 to 5 mm. apart; the basal portion of each polyp is narrow, but it gradually widens towards the apex, becoming again slightly contracted about the middle. The polyps measure from 4 mm. to 4.5 mm. in height, with a diameter of from 1 to 1.5 mm. The tentacles are retractile.

The spicules on the basal portion of the bodies of the polyps are small and scattered all over the surface, towards the middle they become arranged into eight rows, which when the polyps are contracted are continued over the oral cavity, upon the base of the tentacles, forming an imperfect operculum.

The spicules are of a wavy spindle form, with sometimes one extremity expanded; at other times, the terminal points are very finely dentate; a few unsymmetrical double spindles and minute lenticular forms occur.

Spicule measurements, 0.68–0.08; 0.76–0.03; 0.6–0.04 mm.

*Habitat*.—Station 70, June 26, 1873; lat. 38° 25' N., long. 35° 50' W.; depth, 1675 fathoms; bottom, Globigerina ooze.

Subfamily 2. CHRYSOGORGINÆ.

*Chrysogorgidæ*, Verrill, Bull. Mus. Comp. Zool., vol. xi. No. 1, p. 21, 1883.

Colony branched. The axis invariably consists of a main stem, springing from a calcareous base, which is either disc-like or stoloniferous, and of branches, which come off from the stem in an ascending spiral. The latter are either uniserial (*Iridogorgia*), or



verticillate (*Dasygorgia*, *Chrysogorgia*). The branching takes place on the principle of the uniparous helicoid cyme; *i.e.*, the branch gives off twigs on one side which again bear lateral twigs in the same manner. These may again bear lateral twigs of from the second to the fifth order. At the point where each twig comes off the branch or twig is bent at an angle in the opposite direction. The same occurs in the stem at the points where the branches are given off. If there are only a few branches in a spiral and the nodes are many, then the stem appears to be bent in a zigzag manner.

The cœnenchyma is usually thin, and in the younger branches allows the colour of the axis to show through. The polyps are large, and either stand at right angles to the stem or branches or are directed obliquely towards the apex of the branches. On the stem and branches they are placed far from one another, on the branches that subdivide into twigs there is only one on each node. The tentacles are not capable of being withdrawn into the body; in repose they simply fold themselves together over the opening of the calyx.

In addition to the tentacle-bearing polyps there are in many species (*Iridogorgia*, *Dasygorgia*) wart-like zooids. They have a laterally placed oral opening and a terminal cushion of ectoderm, which is filled with thread-cells. From their body cavities canals are given off, which open into the longitudinal canal system.

The axis is horny and arises direct from the purely calcareous basis. It contains, besides the chitinous lamellæ, especially in the stem and the thicker branches, a calcareous deposit, which often imparts to it a brittle consistency. In the finer twigs the horny substance predominates and so gives rise to flexible, elastic rods. The surface of the axis appears shining and exhibits iridescent colours which give it a metallic, or mother-of-pearl-like lustre.

A microscopical examination of the surface of the axis shows the presence of fine calcareous granules on the outermost chitinous layer, arranged in a peculiar order.

The spicules in the cœnenchyma and in the polyps are transparent, glass-like spindles or scales, which form a superficial and a deeper layer. They are sometimes smooth, sometimes provided with fine spines and warts, and lie close together, frequently overlapping one another at the edges. In the polyps they are placed either transversely or longitudinally, and in *Dasygorgia* and *Chrysogorgia* are continued into the tentacles, but the pinnules, which are folded towards the inside in repose, are free of spicules.

This subfamily equals the family Chrysogorgiidae established by Verrill<sup>1</sup> to include the genus *Chrysogorgia* of Duchassaing and Michelotti, and two new genera, *Iridogorgia* and *Dasygorgia*. Verrill gives the following diagnosis of the family:—"Coral variously branched, the branches most commonly taking a spiral arrangement. Axis partially calcareous, generally with a brilliant iridescence and metallic lustre. Base in most of the species calcareous and divided into irregular, divergent, root-like processes, but usually the

<sup>1</sup> *Loc. cit.*

hard, white, calcareous base is strongly contrasted with the axis of the stem. The calicles are prominent, scattered along the branches, either standing at right angles or obliquely; they are covered with moderately large, elongated or flat spicula, and are usually eight-lobed at the summit. Cœnenchyma very thin, with oblong or elongated spicula."

With our knowledge of the simple, unbranched form of *Strophogorgia*, which in the structure of its polyps and the formation of its axis and spicules shows so near a relationship to *Dasygorgia*, it seems well to unite these in one family, Dasygorgidæ, making Verrill's family of the Chrysogorgidæ a subfamily, for which the family characters laid down by him still hold good.

With regard to the relationship of the Chrysogorginæ to other Gorgonids, Verrill has pointed out their close connection with Isidæ and Primnoidæ. The relationship to the Isidæ is strengthened by the examination of the new genus *Primnoisis*, which in the structure of the polyps stands very close to the scaly forms of *Dasygorgia*. To the Chrysogorginæ must also be referred the genus *Riisea*, Duch. and Mich., which, as regards branching and structure of the polyps, unites itself with this family.

[Genus 1. *Iridogorgia*, Verrill.

*Iridogorgia*, Verrill, Bull. Mus. Comp. Zool., vol. xi. No. 1, pp. 21, 26, 1883.

With a spiral axis, from which a single series of long, slender, simple branches is given off on the outer side so that they likewise have a spiral arrangement. Zooids as well as polyps are present.

*Iridogorgia pourtalesii*, Verrill.

*Iridogorgia pourtalesii*, Verrill, *loc. cit.*, p. 27.

*Habitat*.—Off Dominica; depth, 542 fathoms.  
Off Guadeloupe; depth, 743 fathoms.]

Genus 2. *Dasygorgia*, Verrill (*emend.*).

*Dasygorgia*, Verrill, Bull. Mus. Comp. Zool., vol. xi. No. 1, p. 21, 1883.

Colony branched, consisting of a main stem and branches, which again give off twigs, and, indeed, follow the type of the uniparous cyme. The cœnenchyma is thin, with two layers of calcareous spicules. The polyps are large, mostly projecting perpendicularly from the twigs, and arising at wide intervals. There are seldom more than two on a node. The last polyp is never placed terminally, the cœnenchyma and axis are always produced beyond its base.

The spicules always form several layers upon the stem and polyps, and are produced along the dorsal sides of the tentacles, but are wanting in the pinnules. They form an

outer layer of scales or spindle-shaped calcareous bodies, which overlap one another on opposite sides and exhibit a very fine sculpture, which, however, can only be made out with a somewhat high magnifying power; and an inner layer of small plates, at times branched, which are united with one another by toothed edges and often exhibit a double or four-fold structure.

The polyps are not retractile, the tentacles which are armed with spicules protect the mouth-opening by folding in over it.

The axis is, for the most part, horny, iridescent on the surface. The base is always calcified.

Verrill<sup>1</sup> included in the genus *Dasygorgia* a number of species of his *Chrysogorgiæ*, which in several characters seem separate from the genus *Chrysogorgia*, with which they have the mode of branching in common.

Verrill's diagnosis runs:—"Coral much branched, often spirally, the branches repeatedly forking. Calicles obliquely placed on the branches, swollen at base, covered with flat, oblong spicula, which are arranged longitudinally or obliquely. Spicula of the cœenchyma oblong or scale-like, nearly smooth." Verrill refers to this genus five species, all from more or less deep water off the coast of New England and the West Indian Seas.

The ramified *Dasygorgiæ* of the Challenger collection may all be referred to this genus, but the diagnosis requires to be considerably emended.

The colony always consists of a main stem, which rises from a calcareous basis, and of branches, which come off from it almost at right angles.

The stem is upright; its axis consists of very close, concentric, horny fibres, with calcareous deposits. Occasionally only it is flexible and elastic near the point. Its colour is golden to a dark brown, the surface is iridescent with metallic reflections in individual places. The stem axis is never straight, but always exhibits, at the places where the branches come off, an angular bending, the apex of the angle indicating the origin of the branch. If the branches arise from the stem in alternating series, the axis shows a zigzag bending along its course. Frequently a spiral twisting of the stem is associated with this. In the simplest case the branches arise from the stem in alternating series from the two opposite sides; they frequently arise from three sides in short, ascending spirals, and in individual cases they arise from five sides in spirals that follow closely upon one another. The ramification of the branches is again highly characteristic, and may best be compared with the form of the uniparous helicoid cyme common in plants.

Every branch gives off twigs from one side only, and every twig may, in the same way, bear lateral twigs, which may further anastomose. At the point where a twig or a lateral twig is given off, the main twig is bent at an angle in the opposite direction. Hence the appearance of bifurcation frequently arises, the twig that comes off forming a

<sup>1</sup> *Bull. Mus. Comp. Zool.*, vol. xi. No. 1, Report on the Anthozoa dredged by the "Blake," p. 21.

right or an acute angle with the next node, a condition which has induced Verrill, in his diagnosis, to make use of the expression "furcately branchec." The branch of *Dasygorgia agassizii* figured in Verrill's work cited above (pl. ii. fig. 4), shows the law of branching signified, only the twigs come off from the branches at acute angles.

The accompanying woodcut is to illustrate this law of branching.

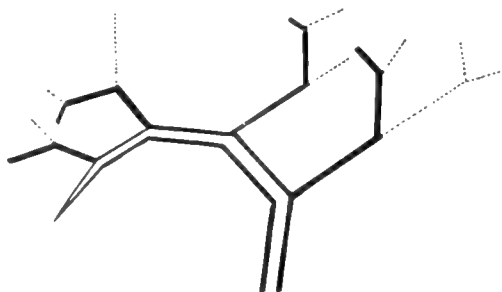


FIG. 1. — Mode of branching in *Dasygorgia*.

The polyps are large in relation to the twigs which bear them. Their form is cylindrical, somewhat enlarged towards the base; their diameter is always greater than that of the supporting twigs. The oral portion, with tentacles, is not retractile; in repose the tentacles are simply folded together over the oral disc, and protect the oral region by means of the spicules situated in their dorsal portions.

In some species the polyps are sparingly scattered on the stem, and on the branches and twigs, so that there are never more than two polyps on a node. The end polyp of the last twig is never apical. The point of the twig always projects beyond the base of the laterally placed polyp. In addition to the tentacle-bearing polyps there are in some species slightly conical zooids without tentacles. Spicules are present in the thin cœnenchyma, in the polyps and in the tentacles, completely filling the outer sides of the latter, while they are absent in the surfaces turned towards the mouth, as well as in the pinnules. There are always two layers of differently shaped spicules. Those of the outer layer are in some species (*Spiculosæ*) long and spindle-shaped, somewhat flattened spicules, blunt at the ends and provided with a fine sculpturing, in the form of little wart-like projections. Large in the polyps, on the dorsal part of the tentacles they take the form of smaller spindles, which lie side by side in from two to four rows, and overlap one another on opposite sides. On the calyx they are arranged longitudinally. The spicules of the cœnenchyma are usually somewhat different from the spicules of the polyps, sometimes larger and sometimes smaller than these. In some other groups, which may be distinguished as *Squamosæ*, the spicules are flattened, almost scale-like, covering each other. Their edges are often finely toothed, frequently lobate, and from the teeth run fine concentric furrows to a small nucleus. They form, on the tentacles, from one to three rows. On the calyx they are placed either obliquely to its long axis

or transversely. The deeper layer in all the species consists of very differently shaped calcareous bodies. First, there are fine, transparent, roundish, oval, biscuit-shaped or lobate forms, which are finely toothed at the edge. They are firmly joined together by these teeth, which interlock in the contiguous plates. Frequently two or more plates fuse, and form double and fourfold ones. In addition to these there are spindle-shaped, warty, and variously branched spicules, always much smaller than the spicules of the upper layer.

So far as can be made out from the material at disposal, the budding of new polyps takes place on the terminal twigs, between the end polyp and the base of the twig.

The buds always arise on one side.

The sexual cells are developed in the basal portion of the polyp. Polyps with eggs have the base distended like a sack, which then projects on both sides beyond the twig which bears the polyp. The dioecious condition appears to predominate. In some colonies all the polyps contain eggs.

The species of the genus *Dasygorgia* are very numerous in deep water. Ten species were collected in the three oceans, of which nine are new. Hence the number of species, counting the five described by Verrill, at present amounts to fourteen.

### A. *Spiculosæ*.

#### 1. *Dasygorgia spiculosa*, Verrill (Pl. IV. fig. 1; Pl. V. fig. 1).

*Dasygorgia spiculosa*, Verrill, Bull. Mus. Comp. Zool., vol. xi. p. 23, pl. ii. fig. 5, 1883.

A colony broken into several pieces agrees in general with Verrill's description, and also with his fig. 5 on pl. ii. The entire fragment is 100 mm. in height; the base is wanting. The main stem is 1 mm. thick at its lower end and appears to be bent in a zigzag manner, forming an angle wherever branches arise; at the same time its axis is spirally twisted. The branches arise from three sides of the stem at nearly right angles, at intervals of from 1 to 1.5 mm. They are themselves also bent at angles and give off lateral twigs almost at right angles, these again develop further lateral twigs. Since the main branches themselves are again somewhat spirally twisted, the twigs lie in different planes. The woodcut explains the ramification.

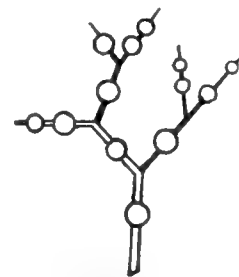


FIG. 2.—The ramification of *Dasygorgia spiculosa*, Verrill.

The longest branches, midway up the stem, reach a length of 25 mm.

The axis is of a yellowish hue, with a shining, somewhat iridescent surface. The stem and branches are rigid and brittle, even to the terminal, hair-like twigs.

The polyps are relatively large, with a very broad base, their length amounts to from 2·5 to 3 mm. They are found only on the branches and twigs, and indeed there is only one polyp on each node of a branch or twig. Only the terminal twig may bear two polyps, one in the middle and one towards the end.

In the superficial layer the spicules consist of spindles, which are covered with fine warts. They usually lie longitudinally on the polyp, and in each tentacle are placed in three rows, which extend right up to its tip. Towards the base of the polyp their direction becomes more oblique to the axis of the calyx, and in the stem they lie parallel to the long axis of the latter. Upon the base of the polyp they are very broad, and cover the stem almost like a pavement; further off upon the stem they soon diminish in size. The length of the spicules in the polyp reaches 0·38; 0·33; 0·37 mm.; with a maximum diameter of 0·05; 0·06 mm. At the base of the polyp they reach 0·41; 0·44 mm., with a breadth of from 0·067 to 0·08 mm. In the stem their length diminishes to 0·16; 0·25 mm. The deeper layer consists of thin, transparent, flat bodies, without spines, and also of little spindles and crescentic forms. Their surface is smooth, or provided with a few little warts. The edges are sharply toothed. The teeth of the different spicules interlock, so that they are united together in a continuous layer. Their size is very variable. Length to breadth in mm.—0·25–0·08; 0·23–0·06; 0·17–0·06; 0·11–0·04; 0·14–0·03; 0·13–0·02. Colour in spirits, white.

*Habitat*.—Station 122, off Pernambuco; depth, 350 fathoms; bottom, red mud.

[Also (Verrill) lat. 25° 33' N., long. 84° 35' W.; depth, 539 fathoms. Off Dominica; depth, 542 fathoms. Off Martinique; depth, 502½ and 334 fathoms. Off St Lucia; depth, 422 fathoms. Off St. Vincent; depth, 573 fathoms.]

2. *Dasygorgia flexilis*, n. sp. (Pl. IV. fig. 2a, b; Pl. V. fig. 2; Pl. VA. fig. 10).

Very like the last, but distinguished by the flexible axis, the more strongly ramified branches, whose twigs form sharper angles with the main branch, by the smaller polyps, and by the form and sculpture of the spicules, which only bear small, scarcely distinguishable warts.

The elegant little stalk rises from a calcareous basal expansion to a height of 100 mm. The slender stem bears twigs from a height of 20 mm. upwards, which arise from three directions at angles of about 40°, at different heights, so that their bases describe spirals, each of which comprises three branches. The base is a calcareous disc, conical, dividing into five flat, root-like processes, the edges of which again give off little rootlets. Above the base the stem is only 1 mm. thick, and ascends in a zigzag manner, bent at the point of departure of each twig, and having at the same time a spiral twist. The branches arise at greater distances from one another than in the last species (2·5 to 3 mm.); about the middle of the stem they attain a length of 30 to 35 mm., and are directed obliquely

upwards at angles of  $35^{\circ}$  to  $40^{\circ}$  to the stem. Their law of branching is the same as in the foregoing species, only the twigs coming off form sharper angles with the branches, and the lateral twigs with the twigs. The terminal twigs are hair-like. The axis is yellowish-brown, the stem has a shining, feebly iridescent surface, soft and flexible, the same in the twigs. It rises sharply and directly from the completely calcified base.

The polyps are pitcher-shaped, with very broad bases, constricted beneath the circle of tentacles. This form seems conditional upon the fact that the lower portion of the body contains in all a great number of ova, and cannot therefore be regarded as specifically characteristic, since it is dependent upon the maturity of the sexual organs at the time.

The spicules of the outer layer are large spindles, rounded off at one end, pointed at the other, often somewhat constricted in the middle. Little warts cover their surface, and at the blunt end are produced into minute teeth. In the polyps they are placed longitudinally, with the blunt end in front, in the tentacles they form four to five rows, towards the base they assume an oblique direction, and then pass up the stem, where they are placed longitudinally; while broad near the polyp, further away they assume a more spindle-like shape, with a blunt end, and they are covered with sharp little spines.

Spicules of the polyps, length to breadth in mm.—  
 0.41–0.07; 0.41–0.04; 0.25–0.03; 0.33–0.03; in the  
 cœnenchyma 0.4–0.04.

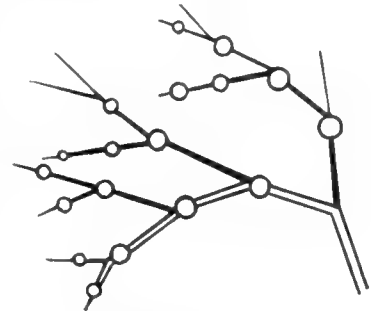


FIG. 3.—Ramification of *Dasygorgia flexilis*, n. sp.

The deeper layer consists of flat, very differently shaped bodies, which are attached to one another by fine teeth. At the base of the polyp they form large, transversely elongated, somewhat crooked bodies, which in their curvature are adapted to the convexity of the body wall. Length to breadth 0.08–0.267; 0.1–0.19 mm.; towards the mouth they become small flat scales or flat spindles without sculpture. In the tentacles one also meets with longish scales with sharp teeth on the edges. Length to breadth 0.1–0.18; 0.04–0.14; 0.04–0.12; 0.06–0.14; 0.12–0.16 mm. Finally there are spindles with serrated edges, one end of which is produced into three or four finger-like processes. Height to breadth 0.2–0.018. In the cœnenchyma the lower layer consists of small plates, of oval, three-cornered, polygonal form, of very different sizes, 0.25–0.05; 0.18, 0.2, 0.1 mm.

*Habitat*.—Station 307; coast of Chiloe; depth, 120 fathoms; bottom, blue mud.

### 3. *Dasygorgia cupressa*, n. sp. (Pl. V. fig. 3).

The strong stem, rising from a flat, expanded, calcareous basis, gives off successive spirals of branches at short intervals. These develop twigs and lateral twigs, which come

off at sharp angles in a horizontal plane. The bending of the branches at the points where the twigs come off is very slight. The terminal twigs are very long, elastic, and flexible. The polyps, which arise with broad bases, are placed singly on the long internodes of the twigs and stand perpendicularly to their axis of support. The spicules are thick spindles, with a few very small warts. They are placed longitudinally in the polyps. The whole stalk, with its abundant, closely placed twigs, which appear to come off from all sides of the stem, recalls in appearance a delicately branched Conifer. The base appears as a flat, calcareous plate, 50 mm. in diameter and 0.5 to 1 mm. thick, which spreads itself out over a piece of recent sandstone. At one side the edge is turned over and holds on to the substratum. The stem rises from the middle of this base. It is sharply marked off from the white calcareous basis, from which it appears to arise directly, by the horny consistency of its axis and the brown colour. The height reaches 150 mm.

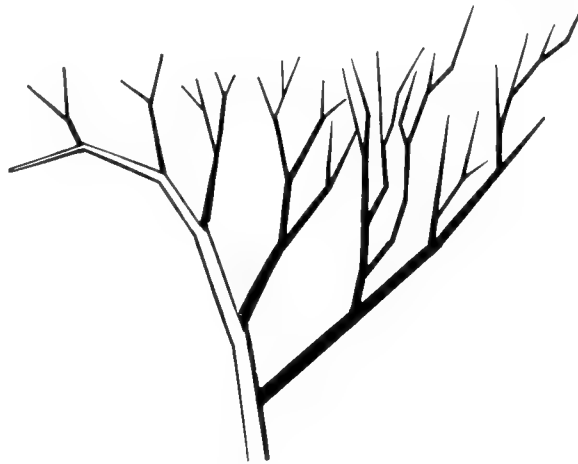


FIG. 4.--Ramification of *Dasyorgia cupressa*, n. sp.

The diameter at the base is 4 mm., and the branches, which commence at 7 mm. from the base, arise at successive heights from four sides of the stem. The fifth is always in line with the first. These five branches form a spiral turn round the stem, and the origin of the individual branches is closely approximated. In the lower part of the stem the difference between the origin of two branches is but 0.5 to 1 mm., while in the upper part it is 1.5 to 2 mm. A spiral turn in the lower part extends over 4 mm. of the stem, in the upper part over 8 mm. The branches leave the stem at rather less than a right angle, are directed somewhat outwards, and are of about the same length from the lower part to near the apex, reaching 50 mm. Their thickness at the point of origin reaches 2 mm.; the bendings which the stem everywhere undergoes at their origin give it the appearance of being twisted spirally around its central axis. The ramification of the branches takes place in the horizontal plane according to the usual law. The main branch is a little bent at the origin of the twigs, the first of which reach the thickness of the main stem.



The ramification is very abundant, every branch giving off twigs, and these giving off lateral twigs to the fifth order. The twigs are always given off at sharp angles. The ramification of the end of the branch frequently takes place in a different plane from the twigs at its commencement, which is caused by the fact that the end of the main branch is bent at an angle out of the horizontal.

The tips of the branches and twigs are thin and hair-like. The axis of the stem and of the twigs is horny, with calcareous deposits at the base of the stem, and in the finer twigs it is flexible and elastic. The colour of the stem and thicker branches is a dark brown, surface shining, iridescent; that of the finer twigs is a glistening yellow.

The cœnenchyma is very thin and transparent, so that the axis is visible all through.

The polyps are cylindrical, with broad bases, scarcely thickened at the ends, 1 to 1.5 mm. long. They are absent on the stem; on the twigs there is, for the most part, one on each node. Only on the end twigs are there from two to three, of which one is immediately below the apex.

The surface layer of spicules consists of thick spindles, blunt at the ends, which lie close together. Their direction in the polyps follows the longitudinal direction of the latter, they are continued up the tentacles in three or four rows. Their surface is raised into slight warts, which with a low power can only be recognised as slight marginal teeth, but with a high power (Hartnack 7) they appear as the expression of rugose elevations, which are placed concentrically around a central nucleus, and might be considered as lines of growth. The size of the spicules reaches—height to breadth in mm. 0.31–0.05; 0.3–0.06; 0.3–0.05; 0.27–0.04.

The lower layer consists of oval, biscuit-shaped, lancet-shaped, flat scales, mostly with finely toothed edges, which are united together by interlocking of the teeth. Length to breadth—0.22–0.1; 0.15–0.06; 0.14–0.03; 0.11–0.03; 0.13 mm.

*Habitat*.—Station 192; off the Ki Islands, south of Papua; depth, 140 fathoms; bottom, blue mud. Three examples.

[4. *Dasygorgia agassizii*, Verrill.

*Dasygorgia agassizii*, Verrill, Bull. Mus. Comp. Zool., vol. xi. No. 1, p. 22, pl. ii. figs. 4, 4a, 4b, 1883.

*Habitat*.—George's Bank; lat. 41° 24' 45" N., long. 65° 35' 30" W.; depth, 1242 fathoms. No specimen was obtained by the Challenger.

5. *Dasygorgia elegans*, Verrill.

*Dasygorgia elegans*, Verrill, Bull. Mus. Comp. Zool., vol. xi. No. 1, p. 23, 1883.

*Habitat*.—Off Granada, 291 fathoms. Off Barbados, 237 and 347 fathoms. No specimen was obtained by the Challenger.]

6. *Dasygorgia squarrosa*, n. sp. (Pl. V. fig. 4).

The slender, slightly bent stem bears only a few branches, which arise from four sides at considerable distances from one another, and give off a few twigs at oblique angles. The ramification takes place in several planes. The axis is dark brown, horny, brittle. The polyps are placed far from one another, and stand up perpendicularly from the twigs. The spicules are smooth spindles, longitudinally placed in the calyx, and oval or irregular discs with finely toothed edges, which form the deeper layer.

Of this species there are only a fragment, 70 mm. in length, and several separated twigs, which, however, are sufficient to distinguish the form as a distinct species.

The polyp axis has, to judge from the larger fragment, a characteristic rugose appearance. The main stem is thin, its diameter at the beginning being 1 mm. It appears slightly bent in its course, and the angular bendings at the points whence the branches arise are scarcely visible. The branches come off from the stem at considerable vertical intervals, and are so given off that the fourth branch always stands over the first. Accordingly the points of origin of the branches form long spirals, whose height, from one corresponding branch to another, reaches 39 mm., the vertical distance of one branch from the next following it being 8 to 10 mm. At the origin of the twigs; which arise far from one another, the branches show a strong angular bending, and the twigs form obtuse angles with them. From the twigs arise simple lateral twigs, at obtuse angles.

The bending of the branches and of the outgoing twigs takes place in different planes, sometimes horizontal, sometimes perpendicular to the stem.

The polyps are cup-shaped, mostly somewhat constricted above the base and expanded towards the mouth opening. They are scattered far apart on the stem and branches. There is one polyp to each node on the stem, usually one or two on each node of a branch or twig. The axis is horny, stiff, slightly elastic, and maintains this character right to the end of the twigs. The colour is dark brown, shining on the surface, feebly iridescent.

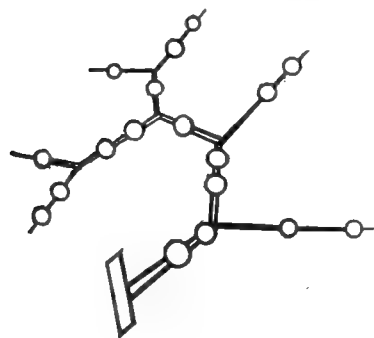


FIG. 5.—Ramification of *Dasygorgia squarrosa*, n. sp.

In the thin, transparent cœenchyma, and in the polyps, the spicules form a superficial layer of smooth spindles, which lie close together, and in the polyps are placed longitudinally. Frequently they are somewhat bent, and generally blunted at one end. Their length to breadth in mm. reaches 0.33–0.06; 0.33–0.04; 0.03–0.04; 0.44–0.067; 0.35–0.04.

Those of the inner layer are flat, oval, smooth scales, or lancet-shaped to spindle-shaped bodies, which are united together by toothed edges. Sometimes two to four

grow together so as to give rise to double and quadruple forms. Length to breadth 0.19–0.08; 0.3–0.05; 0.16–0.06; 0.2–0.15; 0.15–0.02; 0.3–0.02; 0.2–0.03 mm.

*Habitat*.—Station 214, south of the Philippines; depth, 500 fathoms; bottom, blue mud.

7. *Dasygorgia melanotrichos*, n. sp. (Pl. IV. fig. 3; Pl. V. fig. 5).

The slender, thread-like stem gives off branches at great intervals on four sides, which ramify in different planes very copiously and at obtuse angles, giving off twigs up to the sixth order. The axis is horny, stiff, even to the simplest ramifications, shining, and of a dark brown colour. The polyps, 2.1 mm. in length, are slender, cylindrical, and are always on the short internodes of the twig. The spicules of the upper layer are blunt, flat spindles, covered with very fine, sharp warts, often somewhat constricted in the middle, and exhibiting fine lines radiating from a central nucleus. In the polyps they are longitudinally placed, towards their base they assume an oblique direction, and pass into the very thin cœnenchyma, in which they become broader and shorter, almost scale-shaped.

This species, of which only the stem (without the base) and several branches were obtained, in habit very closely resembles the former, from which it differs in the more abundantly ramified branches, and in the form of the spicules and polyps.

The stem is thin, not bent in its course, and of tolerably uniform thickness. Its diameter reaches, at the lower end, 1 mm. The branches first arise at a height of 105 mm. from four sides, at unequal, but very great intervals. The distance between the first and second is 11 mm., between the second and third 14 mm., between the third and fourth 45 mm. The branches are angularly bent, in different planes, at the places where the twigs arise; the twigs come off at oblique angles and give off lateral twigs at similar angles, which are again bent in a zigzag manner and give rise to twigs. The last twigs may be of the sixth order. The internodes are not very long, 5 to 6 mm. Hence arises an uncommonly rich, wide-spreading ramification.

The polyps are cylindrical, 1.5 mm. long, with broad bases; usually there is one perpendicularly placed polyp on an internode, seldom two.

The axis is horny, dark brown, shining and somewhat iridescent on the surface, slightly flexible and elastic. In the main stem it is thread-like, in the finer branches it appears like a stiff horse hair.

The spicules of the outer layer are broad spindles, with rounded ends and somewhat sinuous edges. Under a higher power fine lines are seen radiating from a central nucleus to the edges, and they are found to be provided with sharp little thorns, which form little points on the edges. Their length to breadth in mm. reaches in the polyps 0.29–0.06; 0.26–0.07; 0.28–0.067; in the tentacles 0.22 and 0.25–0.04; in the cœnenchyma 0.21–0.033; 0.16–0.025; 0.2–0.05–0.058.

*Habitat*.—Station 343, Ascension Island; depth, 425 fathoms; bottom, volcanic sand.

[8. *Dasygorgia splendens*, Verrill.

*Dasygorgia splendens*, Verrill, Bull. Mus. Comp. Zool., vol. xi. No. 1, p. 25, 1883.

Off Santa Cruz; depth, 580 fathoms. "Blake" Expedition. No specimen was obtained by the Challenger.

B. *Squamosæ*.9. *Dasygorgia squamata*, Verrill.

*Dasygorgia squamata*, Verrill, Bull. Mus. Comp. Zool., vol. xi. No. 1, p. 24, 1883.

Off St. Vincent; depth, 573 fathoms. Off Barbados; depth, 237 fathoms. "Blake" Expedition. No specimen was obtained by the Challenger.]

10. *Dasygorgia expansa*, n. sp. (Pl. IV. fig. 4a, b; Pl. V. fig. 6).

The upright stem is angularly bent at the origin of each branch, so that it assumes a zigzag form. The branches arise from three sides of the stem, richly ramified at different levels, the twigs coming off at right angles. Sometimes the twigs of two branches anastomose. The axis is hard, brittle, yellowish, but a little flexible in the fine twigs. The polyps are short. Polyps and coenenchyma contain, in the outer layer, broad, minute scales, which overlap, and in the polyp are placed transversely to its long axis. In the tentacles there are longitudinally placed spindles. The lower layer contains irregularly shaped, small, longish, calcareous spicules, with toothed edges, which are firmly connected together.

Of this species only fragments of the stem, with branches, and single torn-off branches were found. The stem is upright, its diameter reaches 1 mm. It gives off branches from three sides, which arise at distances of 2.5 to 3 mm. from one another. The fourth branch always stands in line with the first. At the point of origin of each branch the stem is angularly bent, so that its whole course acquires a zigzag form. The branches, which are angularly bent on different sides, and at the same time undergo a spiral twisting in their course, give off similarly formed twigs at right angles; the further ramification extends to twigs of the fourth order. The thin terminal twigs are relatively short, the internodes up to 8 mm. long. Owing to the ramification in different planes and the relatively close sequence of the branches, it frequently happens that the twigs of two branches cross one another, and then in some cases an anastomosis follows.

The polyps are cup-shaped, and are placed obliquely; usually there is only one on an internode.

The spicules are flat, scale-shaped bodies, with somewhat undulating edges; in the polyp they are placed transversely; the upper edge of the lower ones, which often exhibits

a convex projection, covers the even edge of the next following; thus also the lateral edges cover one another. Towards the base of the polyp the scales become smaller, and are irregularly placed, and at length pass over into the three-cornered or irregularly polygonal scales of the cœnenchyma. Length to breadth in mm.—0·3 and 0·29–0·6; 0·41–0·06; 0·38–0·25; 0·38–0·15.

In the tentacles the spicules are spindle-shaped, flat bodies, which are placed longitudinally and form three or four irregular rows, as in the *Spiculosæ*; they measure from 0·35 to 0·09 mm.

The lower layer comprises small, irregular, flat, longish forms, often biscuit-shaped, or lobed with toothed edges, 0·14–0·06; 0·12–0·05; there are also double and quadruple forms.

*Habitat*.—Station 170, off the Kermadec Islands; depth, 520 fathoms; bottom, volcanic mud.

11. *Dasygorgia geniculata*, n. sp. (Pl. IV. fig. 5; Pl. V. fig. 7).

The small, slender, elastic stem is upright, bent in a zigzag manner owing to its undergoing an angular bending at the origin of each branch. The branches arise in spirals from three sides of the stem at great intervals, the fourth stands in line with the first. The branches are usually ramified horizontally to the stem, and give off twigs of the third order, which come off nearly at right angles. The polyps are placed on the stem and branches; on the stem in short spirals, on the branches one or two on an internode. The polyps are covered with small scales, which overlap one another on opposite sides and lie transverse to the axis of the polyp; the scales are continued up the tentacles in two rows. The cœnenchyma contains small, spindle-shaped to flat bodies, placed parallel with one another.

The colony described is without its base, and has a height of 120 mm. The little stem, in the lower part, has a diameter of 1·5 mm. The branches arise at considerably wide intervals of 3 mm.; at the commencement they are a little thinner than the stem. They come off from three sides of the stem, the fourth branch comes again into line with the first, and hence a spiral of three branches is formed. The height of the spiral reaches constantly 10 mm. At the origin of each branch the stem undergoes an angular bending on three sides, which gives it a zigzag form and makes it appear like a spiral twisted round a central axis. The branches form nearly right angles with the stem. The branches give off twigs from one side in a horizontal plane. They are bent at angles in the opposite direction to the expansion of the twigs. The twigs bear lateral twigs, and these only in individual cases bear twigs of the third order. The terminal twigs are short, spine-like. The length of the branches reaches 25 mm., and the length of the internodes 5 to 6 mm.

The axis is hard, but elastic, yellowish-brown, with a shining, somewhat iridescent surface.

The polyps have a length of 2 to 2.5 mm. They are pitcher-shaped, and in the specimen examined their bases are expanded in a sac-like manner owing to the great number of ova which they contain. On the stem and on the twigs there is, on an average, one polyp on an internode, seldom two. The cœnenchyma on the stem and branches is thin, yet only slightly transparent.

In the polyps the spicules are thin, transversely elongated scales, the upper edges of which cover the base of the next following. Their edges are undulating to lobate, the upper edge in particular being provided with a projecting convex lobe. One lateral edge usually appears drawn out into a point, the other blunted. The lower edge is notched. By way of sculpture the scales exhibit fine lines, which radiate from a central point.

The height to length in mm. reaches 0.25–0.1; 0.26–0.12; 0.33–0.12. In the cœnenchyma the spicules are smaller and more simply constructed, 0.21–0.04; 0.22–0.06 mm.

The deeper layer consists of much bent, rod-shaped forms provided with off-shoots and processes, and smooth forms which frequently exhibit a double and quadruple formation. At the base of the polyp, thin spicules, bent so as to correspond to the periphery thereof, and bearing teeth and spines on the convex side, form a ring around it; they reach 0.41 mm. in length. Further up they are straight, thorny, with three or four root-like processes at one end, 0.3 and 0.25 mm. long. In the cœnenchyma 0.12–0.05 mm.; 0.21–0.04 mm.; 0.11; 0.2–0.06 mm.

*Habitat*.—Station 232, *Hyalonema*-ground, south of Japan; depth, 345 fathoms; bottom, green mud.

Station 201, off the Philippines; depth, 82 and 102 fathoms; bottom, stones, gravel.

12. *Dasygorgia acanthella*, n. sp. (Pl. IV. fig. 6; Pl. V. fig. 8).

The upright stem gives off branches in quick succession from four sides, which arise from the stem in short spirals. The branches come off from the stem nearly at right angles, and are bent in different planes at the points where the twigs come off. Ramification proceeds to the fifth order. The polyps are placed abundantly on the stem, about two in each of the short internodes; on the branches one or two in an internode; on the terminal twigs often three. The stem polyps are short and flattened, in contrast to the polyps on the twigs, which are obliquely directed towards the apex of the twig. Imbedded in the cœnenchyma of the axis there are little conical zooids. The scales of the polyps overlap one another on opposite sides, and are broad, flat and transversely placed; they are continued into the tentacles in two or three rows. The scales of the

cœnenchyma are smaller. The axis is brittle, inflexible, yellowish-brown, smooth on the surface, brightly iridescent.

This species, represented by a colony broken into several pieces and wanting the base, is distinguished from those most nearly related to it by the copious branching, which takes place in different planes, so that the colony acquires a bushy appearance; by the development of numerous polyps on the stem, which have a somewhat different structure from those of the branches, and by the little zooids, which protrude from the cœnenchyma and give to it a roughened appearance.

The main stem rises in an erect manner, its length reaching 200 mm., and in the lower part it is 2 mm. in diameter. At short intervals it gives off branches at right angles, which are 1.5 mm. distant from one another. These form regular spirals around the stem, so that the fifth branch then comes to be in line with the first again. The little angular bendings which the stem undergoes at the point where each branch comes off, give to its axis a spiral appearance. The ramification of the branches takes place according to the usual rule. The main branch, which in the upper third of the stem reaches 30 mm. in length, is angularly bent in different planes, but usually horizontally to the stem, and gives off twigs of a like nature, from which arise twigs up to the fifth order. All stand at angles of  $40^{\circ}$  to  $45^{\circ}$  to one another. The internodes are, on an average, 4 mm. long.

On the stem are placed polyps, with very short calices and wide oral discs from which the eight tentacles arise, they are placed in spirals around the stem, and there are always two between each pair of branches. The tentacles are expanded in all, and the power of contraction appears to be less in the axial polyps than in those of the branches.

On the branches and twigs there is one polyp on each internode, on the thicker branches this is perpendicular to the base, on the terminal twigs it is directed obliquely outwards. Its base is expanded, the body being constricted in front of the calyx opening. The length reaches 2 mm.

The zooids are conical-shaped bodies of 0.12 to 0.15 mm. in length, 0.05 mm. in diameter, which are abundantly scattered in the cœnenchyma of the stem and branches, and cause the surface of the latter to appear as though roughened. Every zooid exhibits an ectodermal covering, which is considerably thickened on the summit of the conical body, and contains a number of thread-cells; at one side, between the base and the apex, is the mouth-opening, which in the different zooids appears sometimes circular, sometimes a mere slit, which seems to indicate the existence of a considerable extensibility of the opening.

No cesophageal tube can be recognised, and the digestive cavity passes directly into a longitudinal canal of the cœnenchyma.

The axis in the stem is hard and brittle, yellowish, with shining surface, which is strongly iridescent. In the branches the axis becomes more flexible and elastic.

The spicules of the polyp are large and broad, and overlap each other at the edges, they are continued up the tentacles in two rows. Their form is unsymmetrical. Generally a portion of the finely toothed upper edge projects forwards as a lobe; the one lateral edge appears truncated, the other rounded off. The height to length in mm. reaches 0·32–0·33; 0·1–0·23; 0·12–0·22.

The coenenchyma has scales of an oval or irregularly rounded shape, 0·16–0·28; 0·12; 0·1–0·23 mm.

In the zooids there are little spinulose spicules; either a small disc-like scale with a spine and serrated edges, or with a blunt process, sometimes bifurcate at the end.

Disc-like spicules 0·12 mm., spine 0·16 mm. Flat portion of disc 0·2, spine 0·2 mm. Disc 0·14, spine 0·21 mm. The deep layer of spicules consists of small, oval, four-cornered, lancet-shaped, or three-cornered little bodies, 0·12, 0·08, 0·1 mm. in diameter, which are connected together by toothed edges.

*Habitat*.—Station 171, north of the Kermadec Islands; depth, 600 fathoms; bottom, hard ground.

13. *Dasygorgia axillaris*, n. sp. (Pl. IV. fig. 7; Pl. V. fig. 9; Pl. VA. fig. 11).

The upright little stem is angularly bent at the point of departure of the branches, and gives off branches at right angles, which are placed around the stem in spirals on three sides. The fourth branch stands in line with the first. The ramification takes place in different planes and proceeds to twigs of the fifth order. The polyps are small, pitcher-shaped, and are placed perpendicularly to their support. The axis is horny, elastic, flexible; in the stem, yellow, shining, with iridescent surface. Zooids are present on the coenenchyma in great numbers. The scales of the polyps are relatively large, unsymmetrical, placed transversely to the long axis, iridescent. At the base of each tentacle stand one or two larger scales, whose upper edge projects above the base of the tentacle. The scales of the coenenchyma are small, irregular, little plates.

The stem of the larger colony, which is broken off immediately above the base, is 100 mm. high, its diameter at the lower end reaching 1 mm. The branches first arise at a height of 50 mm., but their points of origin are traceable down to 15 mm. above the base. The branches come off from the stem in three directions, their points of origin form ascending spirals, the fourth branch always comes into line again with the first. At the origin of each branch the stem is angularly bent in the opposite direction, and the branch forms with it an obtuse angle. Since the bending takes place according to the three directions in which the branches arise, the axis appears to be spirally twisted. The difference in height between two branches, or the length of a stem internode, is 3 mm. The ramification of the branches takes place on the usual principle. The main branch, slightly thinner than the stem, is at first angularly bent in the horizontal plane



and then in the vertical plane, at the point of departure of the twigs, and gives off the lateral twigs at angles of  $40^{\circ}$  to  $45^{\circ}$ ; the branching proceeds to the development of twigs of the fifth order. The length of the branches reaches 40 mm., that of the internodes 3 to 3.5 mm.

The polyps are placed only on the branches and twigs, they are wanting even on the first internodes, then comes one polyp to each internode. The polyps are small, with broad bases, constricted in front of the mouth-opening; their length reaches 1 to 1.5 mm. The zooids are like those described in the preceding species. The body is 0.12 mm. long, and the ectoderm at its apex is very thick and full of thread-cells, the latter forming, in certain states of contraction, a cap-like hood which calls to mind the batteries of thread-cells in the tentacles of many Hydroids, such as *Coryne*. The mouth-opening is lateral, and has, when contracted, a three-cornered or a slit-like form. Here also no oesophageal tube could be distinguished.

The axis is elastic and flexible, in the main stem as well as in the twigs yellowish; in the thicker branches and in the stem shining, and iridescent. The upper layer of spicules consists in the polyps of flat iridescent scales, which overlap one another. Under a high magnifying power one sees that the edges are finely toothed, and that fine wrinkles radiate outwards from a central nucleus to the edges. The scales, which are placed transversely to the long axis of the polyp, are dissimilar. Those appear greatest which are placed immediately at the base of the tentacle, their upper edges project in front of the base of the tentacle. Thereby an operculum is formed, such as occurs in such full development in the Primnoidæ.

The scales of the calyx are usually unsymmetrical, the lower edge generally somewhat indented, the edge of one side straight, truncated, the other pointed. Height to breadth in mm. 0.12–0.35; 0.13–0.48; 0.25–0.41. The spicules of the cœnenchyma are smaller scales of oval, often biscuit-like shape, measuring 0.1–0.18; 0.11–0.67 mm. The spicules of the deeper layer are oval, flat, or spindle-shaped to rod-shaped, at times branched, 0.12 mm. long; at the base of the polyp they are bent according to the curvature of the periphery and are 0.23 mm. long.

*Habitat*.—Station 201, off the Philippines; depth, 82 and 102 fathoms; bottom, stones, gravel.

Station 171, north of the Kermadec Islands; depth, 600 fathoms; bottom, hard ground.

14. *Dasygorgia japonica*, n. sp. (Pl. IV. fig. 8; Pl. V. fig. 10).

From a main stem, which is curved and many times bent, arise branches, chiefly from one side. Some of these are as thick as the main stem and again give off stout branches, which develop lateral twigs in one direction to the sixth order. Branches and

twigs lie all in one plane. The cœnenchyma on the stem and larger branches is thick, on the twigs thin and transparent. The polyps are large, cylindrical, and up to 4 mm. in length. They have a broad base and are placed obliquely to the stem. They are numerous on the stem and on the main branches, so far as one can tell in the uninjured places, there are as many as four in a spiral in one internode; on the thinner twigs there are two, laterally placed, in an internode, on the terminal twigs three or four. In addition to the polyps there are, in the cœnenchyma of the larger branches and of the stem, zooids without tentacles. These form conical structures which project 0.5 mm. above the cœnenchyma. They are placed abundantly between the polyps, and are recognisable with the unassisted eye as little warts.

The axis is hard, horny, in the stem and in the thicker twigs inflexible and brittle, in the finer ramifications flexible and elastic. Its surface is shining, with very intense metallic reflections. The spicules of the cœnenchyma are lancet-shaped, flat, somewhat iridescent bodies, which lie close together and partially overlap one another on opposite sides; they are continued into the zooids, in which they are longitudinally placed. In the polyps the spicules are transversely placed, overlapping, broad oval to lancet-shaped scales, which are finely toothed at the edges; in the tentacles there are longitudinally placed, broad spicules, with truncated ends, sometimes forked on one side.

This form would show a very different ramification from the other species of the genus, if we had before us, in the existing fragment, devoid of the lower end, a complete colony. But the whole mode of ramification agrees so completely with that of a single branch of the species hitherto considered, that we may pretty safely assume that we are here only dealing with the torn-off branch of a really gigantic colony.

The main stem has at its lower end a diameter of 5 mm., it gives off immediately, on one side, a branch of 3 mm. diameter, and 9 mm. higher up a branch of 3.5 mm. diameter; at these points it undergoes an angular bending towards the opposite side, and then, after giving off another thick branch, 4 mm. in diameter, at a distance of 45 mm. higher up, in the direction of the former, it is produced into a tall portion bent in a zigzag manner. The height of the portion which may be regarded as the main stem reaches 300 mm. At each angle which the stem forms thinner branches arise, which again bear twigs, and the three stout branches behave in the same way; the last fine twigs of the latter belong to the fifth and sixth order. Each of the larger branches, like the main stem, gives off, in addition to three or four twigs which have the same thickness as their main stem, numerous smaller twigs, which undergo further ramification only to a slight extent. Branches and twigs come off at acute angles; their internodes are large, in the larger twigs 9 to 10 mm. long. The entire ramification takes place in one plane. The colony may be characterised as branched in a one-sided, fan-like manner.

The cœnenchyma on the thicker branches is thick and easily stripped off; on the thinner twigs it is transparent. The polyps stand upright on the stem and thicker

branches, they are cylindrical, on the twigs they look directly upwards; on the thinner twigs there are usually two on an internode, on the stem and the thick branches four, standing around the stem in an ascending spiral. The zooids, which under a low magnifying power appear as little villi, covering the cœnenchyma in the neighbourhood of the polyps, are 0.5 mm. high, obtusely conical structures with a simple mouth-opening. The ectoderm in this case is but slightly thickened and contains only a few thread-cells, the mouth is slightly below the apex, and the uppermost part projects beyond it as a lobe. Their cœlenteric cavity leads into canals, which first anastomose in a reticulate manner before passing into the longitudinal canals. Some of them contained ova.

The axis is smooth, yellowish brown, in the main stem hard and brittle, in the thin twigs elastic and soft. It exhibits, especially in the thicker branches, brilliant metallic reflections.

The spicules of the cœnenchyma are broad spindles and lancet-shaped bodies, 0.38 to 0.4 mm. long, which are crowded together, partly with their edges overlapping, and follow the longitudinal direction of the twigs. At the base of the zooids they alter their direction and are continued into these in the form of eight longitudinal series. In the polyps the spicules are more scale-like, placed transversely to the long axis, broad, with finely toothed edges and fine wrinkles on the surface, which with oblique illumination give rise to iridescent reflections. Their length to breadth in mm. reaches 0.33-0.15; 0.38-0.15; 0.25-0.12.

In the tentacles the spicules are again longitudinally placed, flat, rod-like structures with blunt ends, sometimes with a short fork at one end. Their length to breadth in mm. reaches 0.23-0.04; 0.2-0.07; 0.25-0.08; 0.26-0.06. The deeper layer of spicules consists of small, flat, rod- or scale-like bodies, which show a tendency towards double and quadruple forms; these measure 0.16-0.15; 0.1-0.04 mm.

*Habitat*.—Station 237, off Japan; depth, 1875 fathoms; bottom, blue mud.

[Genus 3. *Chrysogorgia*, Duchassaing and Michelotti, *emend.* Verrill.

*Chrysogorgia*, Duch. and Mich., Mem. Corall. des Antilles, Suppl., p. 21.

The authors, Duchassaing and Michelotti, describe under the name *Chrysogorgia desbonni*, n. gen. et sp., what are obviously two different Corals. The one represented (*loc. cit.*) on pl. i. figs. 7, 8, is placed among the Primnoaceæ; the second, pl. iv. figs. 5, 6, among the Gorgonaceæ. The first is, according to the description and figure, either a Primnoid, which perhaps belongs to *Plumarella*, or an Isid; to the second Pourtales has referred his *Chrysogorgia desbonni* = *Chrysogorgia fewkesii*, Verrill.<sup>1</sup> Verrill has also recognised the same as *Chrysogorgia* and described it afresh. Unfortunately the originals of Duchassaing and Michelotti are not to be found in the museum of

<sup>1</sup> *Bull. Mus. Comp. Zool.*, Nos. 6 and 7, 1868, p. 131.

Turin. But, according to the precedence of Pourtalès and Verrill, in future only the species described and figured in the *Coralliaires des Antilles*, Supplement, p. 21, can be recognised as *Chrysogorgia desbonni*.

1. *Chrysogorgia desbonni*, Duchassaing and Michelotti.

*Chrysogorgia desbonni*, Duch. and Mich., Mem. Corall. des Antilles, Suppl., p. 21, pl. iv. fig. 4.

„ „ Verrill, Bull. Mus. Comp. Zoöl., vol. xi. No. 1, p. 25, pl. ii. figs. 6, 6a, 6b.

Antilles and Caribbean Sea, 88 to 163 fathoms. Off Cuba, 288 fathoms.

2. *Chrysogorgia fewkesii*, Verrill.

*Chrysogorgia fewkesii*, Verrill, loc. cit., p. 26.

*Chrysogorgia desbonni*, Pourtalès, Bull. Mus. Comp. Zoöl., vol. i. No. 7, p. 131.

Off St. Vincent, 573 fathoms.

Genus 4. *Riisea*, Duchassaing and Michelotti.

*Riisea paniculata*, Duchassaing and Michelotti.

*Riisea paniculata*, Duch. and Mich., Mem. Corall. des Antilles, p. 18, pl. ii. figs. 1, 2, 3.

Köl liker places this next to *Verrucella*.<sup>1</sup> The examination of the type in the Turin Museum, and of specimens from Jamaica, shows it to be closely related to *Dasygorgia*.]

Family II. ISIDÆ.

*Isidinæ* (pars), Milne-Edwards, Hist. Nat. des Coralliaires, vol. i. p. 192.

*Mopseadæ*, *Acanelladæ*, *Keratoisidæ*, and *Isidæ*, Gray, Cat. Lithophytes, pp. 13, 16, 18, 19.

*Isidæ* (pars), Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 661.

*Ceratoisidæ*, Verrill, Bull. Mus. Comp. Zoöl., vol. xi. p. 9.

*Isidinæ* and *Melithæaceæ* (pars), Köl liker, Icones Histiol., vol. i. pp. 140, 142.

The genus *Isis*, as established by Linnæus in 1737, contained an assemblage of several very different generic types; Lamarck would seem to have been the first to properly define it (1801), and in 1816<sup>2</sup> he separated the species of *Melitea* from those of *Isis* proper. Lamouroux added the genus *Mopsea*, and united all three genera into a family, *Isidæ* (1816). This arrangement was followed by Ehrenberg, Dana, and Milne-Edwards. Gray in 1870 divided his suborder Lithophyta into four groups, of which the second, though established on an eminently artificial basis, is almost the same

<sup>1</sup> Icones Histiol., p. 140.

<sup>2</sup> Hist. Anim. sans Vert., t. ii. p. 298.

as the family Isidæ as now understood; this unnamed division of Gray's contains his four families of Mopseadæ, Acanelladæ, Keratoisidæ, and Isidæ. Verrill makes his family Ceratoisidæ include Mopseadæ of Gray, but makes no reference to the species of the genus *Mopsea*, which for reasons given further on seem to be well and easily distinguished from the forms otherwise included in the Ceratoisidæ. It has therefore appeared better to make the family, to which we give Lamouroux's name, include the following subfamilies. It may be diagnosed thus:—

Colony consisting of a simple or branched axis. The axis consists of calcareous and horny (internodal and nodal) regions; the branches when present arising from either the nodal or internodal regions, sometimes anastomosing; the axis solid or hollow, smooth, fluted or echinulate. The base of the axis calcareous and attached.

The cœnenchyma varies greatly, being either very thick (*Isis*) or forming a thin membranous covering as in some species of *Acanella*, *Primnoisis*, &c. The spicules are either fusiform, scale-like, or of a six-rayed stellate form.

The polyps are scattered over the main stem or branches, rarely unilaterally arranged; they are for the most part prominent, though in the genus *Isis* they are retractile within the cœnenchyma; in those with prominent polyps the polyp bodies are more or less densely covered with spicules, some of which often project and form a "calyx" round the oral region of the polyp; the polyp tentacles are externally covered with spicules, they are only very imperfectly retractile, but when folding over the oral region they constitute a quasi-opercular covering somewhat as in the Dasygorgidæ.

- |               |   |
|---------------|---|
| Subfamilies { | 1. Ceratoisidinæ.—Spicules fusiform.      |
|               | 2. Mopseinæ.—Spicules scale-like.         |
|               | 3. Isidinæ.—Spicules hexradiate-stellate. |

#### Subfamily 1. CERATOISIDINÆ.

*Keratoisidæ*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 18.

*Acanelladæ*, Gray, *loc. cit.*, p. 16.

*Mopseadæ (pars)*, Gray, *loc. cit.*, p. 13.

*Ceratoisidæ*, Verrill, Bull. Mus. Comp. Zoöl., vol. xi. p. 9, July 1883.

This subfamily is established for those species of Isidæ with prominent polyps and fusiform or club-shaped spicules.

The axis may be simple or branched, and is made up of calcareous internodal and horny nodal regions. The former are often hollow, more especially in the apical regions of the main stem or its branches.

Branches when present either arise from the internodal (*Ceratoisis*) or from the nodal (*Acanella*) regions. The base of the axis is calcareous, and is either divided into

several variously shaped, root-like masses, by which the colony is fixed in the mud, or disc-like, when attached to rocks. The cœnenchyma is either membranous or thin, in some species without spicules, in others with either small, oblong, scale-like spicules, or these intermixed with larger fusiform or club-shaped spicules. The polyps are prominent, with imperfectly retractile tentacles; the bodies of the polyps are more or less densely covered with fusiform or club-shaped spicules, of which in some species a certain number project beyond the base of the tentacles and form a defensive calyx. The tentacles are covered with spicules, which when the tentacles are partially infolded serve as an opercular covering.

This subfamily contains the following genera:—

1. *Ceratoisis*, Perceval Wright.—Stem simple or branched. Branches when present arising from the calcareous joints. Spicules fusiform.
2. *Acanella*, Gray (*emend*).—Stem branched. Branches arising from the horny joints. Spicules fusiform.
3. *Lepidisis*, Verrill.—Branches from horny joints. Spicules fusiform and lenticular.
4. *Bathygorgia*, n. gen.—Stem simple. Spicules biclavate.

#### Genus 1. *Ceratoisis*, Perceval Wright.

*Keratoisis*, E. Perceval Wright, Ann. and Mag. Nat. Hist., December 1868, p. 427; January 1869, p. 23.

„ J. E. Gray, Cat. Lithophytes Brit. Mus., July 1870, p. 18.

„ Th. Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, October 1878, p. 662.

*Ceratoisis*, Verrill, Bull. Mus. Comp. Zool., vol. xi. p. 10, July 1883.

*Lepidisis*, Verrill (*pars*), *loc. cit.*, pp. 10, 18.

Axis simple or feebly branched, when branched, the branches proceeding from the calcareous internodes. The internodes are in a young state hollow in most, getting nearly solid by age, but in some apparently remaining as a thin tube of calcareous material, smooth or fluted. Either rooted in the mud by rhizome-like processes or to rocks by a disc-like attachment. Polyps arranged on the axis either irregularly, in verticles, or in a uniserial manner; prominent; the tentacles imperfectly retractile. The cœnenchyma is membranous or thin; sometimes without spicules, but more frequently with either small oblong (lenticular) or large fusiform spicules, or with both. The spicules on the bodies of the polyps either lenticular or fusiform, eight large fusiform spicules starting from below the base of the tentacles forming a defensive calyx.

The lenticular or oblong scale-like form of spicule occurs in *Ceratoisis grayii*, E. P. W., the type form of the genus, and this form of spicule occurs also greatly developed in *Ceratoisis grandiflora*, Th. Std.; so that it would seem impossible to distinguish between the unbranched species of the genus *Lepidisis*, Verrill, and the unbranched

forms of *Ceratoisis*. It is, therefore, thought desirable to emend the characters of the latter genus, so as to admit all the unbranched forms with hollow stems of *Isidæ*. It is of course possible that with increasing knowledge this genus will have to be subdivided. Unfortunately very few specimens of the species of this group were collected during the voyage of the Expedition, so that even the specific characters are not in many cases as satisfactorily determined as could be wished. It is somewhat remarkable that all the species found belong to the unbranched division of the genus.

1. *Ceratoisis philippinensis*, n. sp. (Pl. VA. fig. 5).

Axis unbranched. Calcareous internodes very slightly grooved, somewhat irregular and knobbed, 3 to 4 cm. long, 5 mm. in diameter, but tapering to the thinness of a hair from a horse's tail, apical portion hollow. Nodal regions 5 mm. high, cœnenchyma thick and membranous, covered with both fusiform and lenticular spicules.

Polyps prominent, in irregular verticils rather closely packed on the axis, with tentacles retracted, 6 mm. in height, covered with fusiform spicules, six or eight of which form a calyx around the base of the retracted tentacles.

This species is very closely related to *Ceratoisis grayi*, but differs from it in its mode of growth, in the greater abundance in the cœnenchyma of the lenticular spicules, and in the spicules of the polyps. Six or seven fragments of from 15 to 20 cm. in height, and all apparently forming portions of the same axis, but without a basal portion, were taken at the Philippines.

Spicules in the cœnenchyma, lenticular, sometimes asymmetrical; in the polyps, fusiform, with papilliform endings, sometimes broad, at other times narrow.

The large spicules around the base of the tentacles measure 1·2–0·08; 1–0·01; 2·5–0·1; 1·2–0·1 mm. The lenticular spicules measure 0·87–0·05; 0·2–0·58; 0·25–0·057 mm.

*Habitat*.—Station 201, off the Philippines; depth, 82 fathoms; bottom, stones, gravel.

2. *Ceratoisis grandiflora*, Studer (Pl. VA. fig. 6).

*Ceratoisis grandiflora*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 662.

Axis unbranched; base disc-like, affixed to rocks; calcareous internodes, varying greatly in length, from 1·5 to 5 cm., the shortest near the base, solid towards base, hollow towards apex. Polyps very large, placed on the axis in an irregularly alternate manner. Cœnenchyma thin, membranous, covered with lenticular spicules, which also cover the greater portion of the base of the polyps. Tentacles very imperfectly retractile; six to eight spine-like spicules, with irregular bifid tips, surround the base of the tentacles.

Spicules.—In addition to the remarkable forked spicules, described by Studer, on the polyp bodies and surrounding the base of the tentacles, there are long needle-shaped forms and numbers of flat, irregular, biscuit-shaped spicules.

The large defensive spicules measure 2.5–0.05; 2–0.083 mm. The flattened irregular disc-shaped forms measure 0.83–0.05; 0.85–0.05; 0.28–0.04; 0.22–0.083 mm.

Several greatly damaged specimens of this species, first described by Dr. Studer from Matuku in the Fiji Islands, were found among other Alcyonaria taken off Fiji.

*Habitat*.—Stations 174B, C and D, off Kandavu, Fiji; depth, 255, 610, 210 fathoms; bottom, Coral mud.

3. *Ceratoisis paucispinosa*, n. sp. (Pl. VI. figs. 1, 1a; Pl. VA. fig. 7).

Axis unbranched. From 6 to 7 dm. long; calcareous internodes 3 to 4 cm. in length; base of broad, calcareous, root-like projections; basal internodes solid; apical, hollow and grooved, the whole axis very flexible; a somewhat dense, membranous coenenchyma, free from spicules, covers the whole axis.

Polyps large, 8 to 9 mm. in height, slender, arranged in somewhat irregular alternate verticils, a little crowded to one side of the axis. No spicules on the body of the polyp facing the axis, a few fusiform spicules greatly varying in size on the dorsal aspect, eight large spine-like dentate spicules surrounding the tentacular base of the polyp. Tentacles large, massive, very imperfectly retractile, studded with minute, irregular, dentate spicules.

The large spine-like spicules on the polyp bodies measure 5–2; 5–3.5; 3–0.13 mm. The small needle-like spicules measure 0.14–0.16; 0.4–0.03 mm. The irregular dentate spicules of the tentacles measure 0.13–0.03 mm. smaller.

Three nearly perfect specimens of this species were taken off Japan; it seems an abundantly distinct species.

*Habitat*.—Station 232, *Hyalonema*-ground, off Japan; depth, 345 fathoms; bottom, green mud.

4. *Ceratoisis nuda*, n. sp. (Pl. VI. figs. 2, 2a; Pl. VA. fig. 8).

Axis unbranched. Calcareous internodes 4 to 6 cm. long; in the younger portions hollow, older portions solid. Polyps rather thickly crowded on axis, in irregular verticils, short, with swollen bases. Coenenchyma of axis membranous; puckering into folds on drying; without spicules. Base of polyps without spicules, a few small needle-shaped spicules on the dorsal side of the polyps. The tentacles large, imperfectly retractile, crowded with acicular spicules.

A few broken specimens of this species were found among other Alcyonaria collected on the reefs at Fiji. As no species of this genus has been found in shallow water, it is



probable that this was dredged from deepish water outside the reef. The cœnenchyma is the least protected by spicules of all the species of the genus so far described.

The spicules are but feebly developed, and measure 0·77–0·05 ; 0·73–0·07 ; 0·2–0·03 ; 0·12–0·02 mm.

*Habitat*.—Reefs, Kandavu, Fiji.

#### 5. *Ceratoisis palmæ*, n. sp.

This species is established for a few fragments of a *Ceratoisis*, brought up from a great depth off Palma, one of the Canary Island Group.

The axis is apparently unbranched, and consists of a series of calcareous internodes of about 15 mm. in length, by 1 mm. in breadth, with short horny nodes. The internodes are smooth and hollow.

The polyps are, as far as can be judged from the few present, scattered at long intervals on the axis; they are about 3 mm. in height, and about 1·5 mm. broad.

The cœnenchyma on the axis is thin, membranous, of a dark brownish or yellowish colour.

The spicules on the cœnenchyma are either long, slender, spiny spindles, or short and fusiform. Those of the polyps are large stout spindles, tightly packed; the blunt ends of some five or six project beyond the retracted tentacles, forming a fringe; the polyp spicules are also echinulate.

In some respects this form resembles *Acanella simplex*, Verrill, but the hollow axis and the form of the spicules will easily distinguish it.

The spicules measure 3·0–0·15 ; 2·0–0·15 ; 0·4–0·05 mm. in the cœnenchyma, and in the polyps from 2·5–0·5 ; 2·0–0·15 ; 0·15–0·05 mm.

*Habitat*.—Station 85, July 19, 1873; off Palma; lat. 20° 42' N., long. 18° 6' W.; depth 1125 fathoms; bottom, volcanic mud.

#### Genus 2. *Acanella*, Gray.

*Acanella*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 16.

„ Verrill (*emend.*), Bull. Mus. Comp. Zoöl., vol. xi. No. 1, p. 21, 1883.

This genus was established by Gray for *Mopsea arbusculum*, Yate Johnston, a branched form. It was emended by Verrill so as to include species with unbranched stems.

Axis simple or variously branched; internodal regions long, calcareous, solid; nodal regions short, horny. The branches when present arise from the horny nodes in twos or threes. Base with root-like projections clinging to rocks or anchoring in the mud. The basal calcareous internodes are much shorter than those towards the summit. The cœnenchyma is thin, with fusiform spiny spicules greatly varying in size. Polyps

prominent, with numerous fusiform spicules, sometimes bent or twisted; the base of the tentacles furnished with a row of from six to eight long spine-like spicules; tentacles imperfectly retractile, with minute spicules.

1. *Acanella arbuscula* (Johnston) (Pl. IX. fig. 1).

*Mopsea arbusculum*, Yate Johnston, Proc. Zool. Soc. Lond., 1862, p. 245, pl. xxxi. figs. 1, 1a;

Ann. and Mag. Nat. Hist., ser. 3, vol. xi. p. 299, April 1863.

*Acanella arbuscula*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 16 (woodcut).

Several specimens of what we take to be this species were dredged off Station 3, south of the Canaries. The axis is branched. The branches arising for the most part in the one plane from the horny nodes; two generally from the same node. The base is provided with broad, calcareous, root-like processes, for anchoring in the mud. The cœnenchyma is thin, with numerous fusiform spicules. The polyps show a tendency to a uniserial arrangement. The polyps are almost sessile, with well-developed fusiform spicules, some eight of which project and form a calyx around the base of the nearly completely retractile tentacles. One specimen measures about 20 cm. in height, is more or less fan-shaped, the broad expanse measuring about 15 cm.

There is no trace of any anastomosing of the twigs, as mentioned by Yate Johnston to be the case in the specimen described by him. The species seem very closely related to *Acanella normani*, Verrill (*Acanella arbuscula*, Norman), but the spicules do not appear to be "minutely spinulate" as described by Verrill.

The colour in spirit is a dull brown, but the tentacles are of a much darker hue, and when withdrawn give the appearance of black tips to the polyps. The spicules on the outside of the polyps, and those forming the calycine fringe, measure 3·6–0·1; 3–0·09; 2–0·05 mm. The smaller forms in the cœnenchyma and tentacles measure from 0·13–0·02; 0·3–0·05; 0·6–0·03 mm.

*Habitat*.—Station 3, south-west of the Canaries; depth, 1525 fathoms; bottom, hard ground.

2. *Acanella eburnea* (Pourtales) (Pl. IX. fig. 2).

*Mopsea eburnea*, Pourtales, Bull. Mus. Comp. Zool., vol. i. p. 132, 1868.

*Isidella eburnea*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 15.

*Acanella eburnea*, Verrill, *loc. cit.*, vol. xi. p. 16, 1883.

A much-rubbed specimen of this species occurs in a collection made off Sombrero Island. The cœnenchyma on the axis is thin. The echinulate spicules seem very characteristic of the species. This may be *Acanella spiculosa*, Verrill (*loc. cit.*, p. 17), but contrary to his usual habit, Verrill gives no measurements of the spicules of this species or of *Acanella eburnea*, though he makes the specific differences depend in some measure on their relative size.

The spicules measure 0.5–0.09; 0.67–0.04; 0.89–0.05; 0.4–0.06; 0.06–0.015 mm.

*Habitat*.—Station 23, Sombrero Island; depth, 450 fathoms; bottom, Pteropod ooze.

3. *Acanella chiliensis*, n. sp. (Pl. IX. fig. 3).

Axis with root-like calcareous processes from base; branches from horny nodes in twos and threes forming irregular verticils; calcareous internodes smooth. Colony from 10 to 12 cm. in height. Polyps prominent, arranged irregularly on the stem and branches. Some about 5 mm. in height are almost sessile, others 7 mm. in height are slightly stalked. Cœnenchyma thin, with echinulate fusiform spicules. Polyps with fusiform spicules, of which six or eight form a protective calyx below the imperfectly retracted tentacles.

Spicules of the cœnenchyma are fusiform, some slightly curved, with spine-like projections, some broad, fusiform, others slightly club-shaped. Those of the tentacles small, irregular, dentate.

The spicules measure 1–0.1; 1.5–0.2; 0.86–0.09; 0.36–0.05; 0.13–0.03 mm.

*Habitat*.—Station 307, in the Messier Channel; depth, 175 fathoms; bottom, blue mud.

4. *Acanella rigida*, n. sp. (Pl. IX. fig. 4).

Colony about 14 cm. in height, bushy. Axis with calcareous root-like processes. Branches from horny nodes, two, three, or four in number, forming verticils. Calcareous internodes short near the base, long near the extremities of the axis and branches, grooved. Axial cœnenchyma thin. Polyps prominent, with broad bases, often at right angles to the stem and branches; rigid, with large, curved, fusiform spicules which are twisted partly round the body of the polyp; several of the larger of these form a protective calyx extending from the base of the polyp to a little beyond the base of the imperfectly retractile tentacles.

Spicules very irregular in shape, large, some wavy in outline, others curved, or with one end narrow and the other irregularly expanded, all with more or less well-developed spines.

Some of the large, external, curved, spindle-shaped spicules surrounding the polyps measure 3.5 mm. in length, with a diameter in the thickest portion of 1 mm., but others measure 2.5–0.3; 2.0–0.1 mm. The spicules on the cœnenchyma are much smaller and less curved.

The internal spicules measure 0.9–0.13; 0.87–0.07; 0.6–0.1; 0.8–0.08; 0.08–0.46; 0.25–0.04 mm.

This species appears to differ in the form of its spicules from all hitherto described.

*Habitat*.—Stations 194 and 194A, off Banda ; depth, 200 and 360 fathoms ; bottom, volcanic mud.

5. *Acanella simplex*, Verrill (Pl. IX. fig. 5).

*Acanella simplex*, Verrill, Bull. Mus. Comp. Zool., vol. xi. p. 17.

Axis slender, apparently unbranched, 1 mm. in diameter ; calcareous internodes sulcated, solid, or in the youngest internodes with a very minute central tube ; horny nodes short. Polyps arranged in an alternate manner on the axis, prominent, about 5 mm. distant on lower portion of the axis, with lesser intervals towards apex, more or less cylindrical in shape, from 4 to 5 mm. in height and about 1 mm. broad. The cœnenchyma on the axis is thin, but when in a perfect condition it is crowded with obtuse fusiform spicules ; these are easily rubbed off. The base of the polyp is packed with larger and more curved fusiform spicules, and the tentacles are stiffened with minute, echinated, oblong spicules ; from six to eight rather blunt fusiform spicules form a projecting fringe around the imperfectly closed tentacles.

This species was described by Verrill (*loc. cit.*) from two specimens, one taken in 334 fathoms, off Martinique, and the other in 399 fathoms off Barbados. It seems to belong to *Acanella*, and it is quite possible that it is a feebly branching form, so that the genus may not require to be emended so as to include simple stemmed forms. The solid calcareous joints will serve to distinguish this form from any of the species of *Ceratoisis*.

The long needle-shaped spicules on the polyp vary greatly in length from 3·5–0·5 ; 2·0–0·5 ; 1·5–0·25 mm. Those on the cœnenchyma and tentacles measure 0·5–0·09 ; 0·67–0·04 ; 0·4–0·06 ; 0·89–0·05 ; 0·06–0·015 mm.

*Habitat*.—Station 56, off Bermudas ; depth, 1675 fathoms ; bottom, Coral mud.

Genus 4. *Bathygorgia*, Perceval Wright.

*Bathygorgia*, Perceval Wright, Narr. Chall. Exp., vol. i. p. 691, fig. 236.

Axis with long, irregularly curved, and somewhat square calcareous internodes and small horny nodal joints. Cœnenchyma of the axis thin ; but covered with oblong warty spicules. Polyps large, uniserial, with non-retractile tentacles, body covered with large, spiny, biclavate, and club-shaped spicules.

*Bathygorgia profunda*, Perceval Wright (Pl. VI. fig. 3 ; Pl. VA. fig. 9).

*Bathygorgia profunda*, Perceval Wright, Narr. Chall. Exp., vol. i. p. 691, fig. 236.

The axis in the only specimen of this remarkable form, dredged during the cruise of the Challenger, is evidently but a fragment ; it is about 6 cm. in length and 1 mm. in

diameter, and consists of three calcareous internodes with two very small horny nodes. The calcareous internodes have a somewhat glassy appearance, are bent or curved on themselves, and slightly quadrangular in section, solid, smooth; towards the apparent summit the section is circular. The cœnenchyma is thin, and densely covered with oblong warty spicules, which become larger at the base of the polyp. The polyps are large, projecting at right angles from the axis, thick, measuring when dry 5 mm. in height and 2.5 mm. in diameter. The non-retractile tentacles are folded over on each other in a somewhat irregular manner; large, club-shaped, spinulate spicules cover the body of the polyp, while small, oblong spicules densely cover the outer portions of the tentacles.

The spicules measure 2.0–0.5; 1.2–0.16; 0.9–0.2; 0.2–0.04; 0.2–0.03; 0.03–0.12 mm. The small ones are found in the tentacles.

The form of the spicules seems to necessitate the formation of a new genus for this deep-sea form, which with its solid axis approaches to the unbranched forms of the genus *Acanella*.

*Habitat*.—Station 241, between Yokohama and the Sandwich Islands; depth, 2300 fathoms; bottom, red clay.

#### Subfamily 2. MOPSEINÆ.

The ramified colony bears polyps, which project above the cœnenchyma and are cup- or club-shaped or cylindrical. The tentacles are not retractile, but when in a state of repose fold themselves together over the mouth-opening. The axis consists of alternating horny and calcareous joints (nodes and internodes); the branches arise mostly from the calcareous joints, but sometimes on their upper edge, so that their horny base comes into contact with the horny joint of the stem. The spicules thickly fill the cœnenchyma, the polyp bodies and the tentacles of the latter. These are generally longish scales, with sharply indented and toothed edges. The scales are placed in contact through their dentated edges, which interlock on opposite sides. In the polyps they are placed transversely and are bent so as to correspond to the contour of the polyp wall; their edges do not overlap one another on opposite sides. In the tentacles they form as a rule three longitudinal rows.

The subfamily, of which *Mopsea*, Lamouroux, may be regarded as the typical genus, includes three genera, of which the first, *Primnoisis*, shows affinities to *Dasygorgia*.

1. *Primnoisis*, n. gen.—Colony ramified in several planes, polyps large, arising at wide intervals. Spicules of the calyx large.
2. *Mopsea*, Lamx.—Colony ramified in one plane, polyps small, club-shaped, standing in close spirals. Spicules of the calyx small.

3. *Acanthoisis*, n. gen.—Colony ramified in one plane, polyps insignificant, cylindrical, with truncated mouth-opening. Spicules of the calyx minute, needle-like. Toothed ribs on the calcareous joints of the axis.

Genus 1. *Primnoisis*, n. gen.

Colony ramified, consisting of a main stem, which gives off branches from three to four sides, usually arising at varying heights, and giving off abundantly lateral twigs, so that the whole colony forms a thick bush.

The cœnenchyma is thin and allows the jointed axis to show through. The polyps are isolated on the stem, numerous on the branches and twigs; in loose to close spiral order. They project either at right angles to their support or their axis is directed obliquely towards the apex of the twig. Their form is club- or cup-shaped, the base broad, the middle more or less constricted, the mouth-opening widened. The tentacles are provided with spicules on the dorsal side, and are folded together in repose inwards over the mouth-opening. The form of the polyps is markedly radial and the mesenterial folds are in great part so filled with calcareous spicules that these remain well preserved and rigid even in dried specimens.

The cylindrical axis consists in the branches and twigs, of alternating internodes of thick, calcareous material and horny nodes. The calcareous joints are long, in opposition to the very short horny joints, and are provided with distinct longitudinal furrows. The branches begin with a horny joint and arise always from the calcareous joints. Sometimes it happens that a branch arises near to the upper edge of the calcareous joint, and that, by thickening of the branch, its first horny joint comes into contact with the horny node of the stem, so that individual branches apparently arise from the horny joints; the terminal joints of the twigs are calcareous.

The base appears, in the single example where it is preserved, as a flat calcareous lamellar disc, which covers foreign bodies.

The spicules form two layers in the cœnenchyma and calices.

The scales of the cœnenchyma are more or less flattened, longish, lancet, rod-like or irregular scale-like bodies covered with warts or spines. Their edges are irregularly indented and serrated, and interlock on opposite sides, so that they form a continuous layer.

In the polyps there is a deep layer of rod-like indented scales, which are placed in eight longitudinal rows and surround the periphery like so many chains; above these are flat, transversely placed scales, with toothed edges and warty or thorny surfaces whose edges interlock. These scales are broad and narrow and constitute a firm skeleton for the calyx. In the tentacles two to three rows of scales form the skeleton. The spicules in

the mesenterial folds are very small, calcareous rodlets, which lie close together and fill the mesoderm of the folds.

The genus, to which four species from the Antarctic Ocean must be referred, exhibits in the contour of its polyps a resemblance to the Primnoids. This, however, is merely superficial; on more careful examination it soon becomes evident that the form and connection of the scale-like spicules are very different. The scales do not overlap, but the upper edge of one scale interlocks with the lower edge of the next above it.

The calices are radial and without an operculum, but the structure of the calyx exhibits close relationship with that of the scaly species of *Dasygorgia*. Here also the calyx has a lower layer of chain-like calcareous rods, over which lie the scales. The condition of the tentacles is also the same in both cases. The genus stands very near to *Mopsea*, to which *Primnoisis ambigua*, in the condition of the calyx and spicules, directly leads.

1. *Primnoisis antarctica* (Studer) (Pl. VIII. figs. 2, 2a, 2b; Pl. IX. fig. 6).

*Isis antarctica*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 661, Taf. v. fig. 32.

The branches arise from each of the calcareous joints of the stem in four directions, generally two, sometimes three, at the same base, the third and fourth, or only the fourth, somewhat higher up. They are unequally developed; generally two opposite ones are stronger than the others; they stand off from the stem at angles of  $35^{\circ}$  to  $40^{\circ}$ . Each branch again gives off lateral branches at acute angles in several directions, often near its base, which may reach the thickness of the main branch and again bear twigs, but the ramification does not go beyond the development of twigs of the fourth order.

The height of the stem, which is also that of the colony, reaches 100 mm. The diameter at the lowest part, where it is broken off from the base, is 2 mm. The branches develop to a length of 35 mm. Length of the terminal twigs reaches 10 mm.

The polyps, 1 to 1.5 mm. long, are placed on the branches and twigs at relatively great intervals, in spirals of three to four. Their form is tall, cup-shaped. They arise with broad bases and exhibit in the middle, before the expanded mouth-opening, a constriction. In repose the tentacles are folded together over the mouth-opening and form with their scales, which cover them, a kind of operculum.

The polyps mostly stand perpendicularly upon the main axes; towards the ends of the branches they are more obliquely placed. The last polyp is never terminal, but is placed laterally on the end twig which runs out into a short point.

The calcareous joints of the stem are cylindrical, distinctly furrowed longitudinally,

considerably longer than the horny joints. Their length reaches 5 to 6 mm., while the bright brown horny discs have only a thickness of 0.5 mm. The calcareous joints are thicker than the horny joints, so that the stem appears to be constricted at each horny joint. The branches arise frequently with a horny joint, but there are also cases in which a calcareous process grows out from the stem, upon which process the branch with its first horny joint is placed.

Usually the branches and twigs consist only of a few long, calcareous internodes, with thin horny nodes.

The scales of the coenenchyma are either rod-like, often bent, or broad, longish, oval or four-cornered scales with sharp teeth and toothed lobes on the edge and pointed spiny warts on the surface. Their teeth interlock on opposite sides. The length to breadth in mm. reaches 0.27–0.03; 0.18–0.03; 0.3–0.1; 0.13–0.05; 0.28–0.1.

Around the base of the polyp these scales form a ring, becoming bent, and finally pass over into the scales of the calyx, which, at first small, resemble the spicules of the coenenchyma, but then become broader and higher. These scales of the calyx exhibit on their upper surface only small, pointed warts, an upper toothed edge, which is almost straight or slightly indented, and a lower edge, which is divided into two lobes by a more or less deep incision. The size of these scales reaches in mm.—height to breadth; at the base 0.02–0.2; in the middle 0.12–0.25; 0.13–0.26; 0.14–0.3; 0.15–0.25; 0.14–0.24.

The tentacles have strong scales, especially in their basal portion, where they are placed obliquely to one another in two rows. Their size reaches 0.1–0.2; 0.1–0.18.

The species was first founded for an axis which was obtained, during the voyage of the "Gazelle," at a depth of 60 fathoms, north of Kerguelen Island. The species had to be provisionally referred to *Isis*, since the nature of the coenenchyma and polyps was then unknown.

The Challenger specimens were obtained in a fairly perfect state, but without their bases, and agree completely in mode of branching and in the nature of the axis with the Kerguelen form, so that there can be no doubt as to the identity of the species.

*Habitat*.—Station 145A, Prince Edward Island; depth, 310 fathoms; bottom, volcanic sand.

## 2. *Primnoisis sparsa*, n. sp. (Pl. VIII. fig. 4; Pl. IX. fig. 7).

The stem, which exhibits frequent bendings in its course, arises from a disc-like, lamellar, calcareous base, which covers over a colony of Polyzoa. It gives off branches from its calcareous joints on four sides; these mostly arise at different heights, and are seldom placed opposite to one another in pairs. The branches are thin, coming off from the stem at angles of 25° to 30°, directed towards its apex. The branches are mostly



simple, they seldom give off one to two short lateral twigs, which do not ramify further. The height of the whole colony reaches 100 mm., the thickness at the base 1 mm. The length of the largest branches 15 to 20 mm.

The coenenchyma is thin, and, in the stem, allows the axis to show through. The polyps are placed on the branches at intervals of 2 to 3 mm. from one another. They project perpendicularly from the branches. Their form can generally be characterised as tall, cup-shaped, the base broad, as also the mouth portion, in the middle slightly constricted. The height reaches 1.5 mm.

The tentacles are in repose bent from the base towards the inside, and form with two-thirds of their length a horizontal lid covering the oral opening. Hence the mouth of the polyp appears evenly truncated.

The calcareous joints of the axis are long, cylindrical, in the stem, their length reaches 10 to 15 mm., while the horny joints appear only as discs of 0.5 mm. diameter.

The branches arise to the number of four from different sides on each calcareous joint, either with a horny joint or from a short, cylindrical, calcareous process of the stem. They contain only three to four long, calcareous internodes, separated by very thin horny nodes.

The spicules of the coenenchyma are longish, flat bodies, with toothed edges, from which sharp ribs run towards the middle line of the spicule, and lying below these are spiny spindles, 0.2 mm. long and 0.06 mm. broad, and spindles of 0.06 mm. in length and 0.012 mm. in thickness.

The scales of the calyx are transversely placed, four-cornered, with lobes on the lateral edges and sharp teeth on all the edges; from the teeth run sharp ribs over the surface of the scale to its centre, whereby its surface appears as though folded. There are also sharp, pointed spines on the scales. Height to breadth in mm.—0.09–0.2; 0.1–0.16; 0.06–0.16; 0.1–0.16.

The tentacle scales have the character of the foregoing; they form three rows, a middle one with broad scales of 0.1 mm. height and 0.13 mm. breadth, and two lateral ones with higher scales with toothed edges. Height to breadth, 0.15–0.05.

The species is distinguished from the foregoing by the sparser manner of branching, the form of the polyps, and the nature of the scales of the calyx, which here appear to be rough and spiny.

*Habitat*.—Station 145A, off Prince Edward Island; depth, 85 fathoms; bottom, volcanic sand.

### 3. *Primnoisis rigida*, n. sp. (Pl. VIII. figs. 3, 3a; Pl. IX. fig. 8).

The colony, unusually richly branched, forms a thick, upright bush, which tapers from the base towards the summit. The main stem is many times bent and

begins to give off branches near its base, which attain to nearly the thickness of the main stem. In one case the lowest branches anastomose with one another, the lowest fuses again with the stem, so that it is difficult to recognise the regular ramification.

Usually there arise four more or less thick branches from each calcareous joint of the stem at different heights and on different sides. Still the tendency to develop the branches, more particularly in one special plane, generally prevails. The largest branches arise from two opposite sides and spread themselves out in the same plane, while the other branches remain shorter. The branches arise at acute angles to the stem. Each branch develops lateral twigs in the same manner as does the main stem, and the ramification proceeds to the formation of twigs of the fifth order. Most of the branches reach the summit of the main stem.

The height of the colony reaches 120 mm. Diameter of the stem at the base 2 mm.

Length of the main branches up to 45 mm., of the thin terminal twigs up to 10 mm.

The polyps are small, inclined inwards towards the branches. They arise from the branches and twigs at considerable intervals from one another, 0.8 to 1 mm. On the larger twigs and branches mostly on three sides, on the terminal twigs only on one side.

Their form is club-shaped, the base broad, the mouth rounded off, the middle constricted. Length, 0.8 mm. They seem, like the Primnoids, in a position to bend themselves inwards towards the branches.

The calcareous joints of the axis are long, cylindrical, frequently bent and twisted. In the main stem and larger branches 10 mm. long. The horny joints, on the other hand, are very short, yellow-brown. The branches always arise entirely from the calcareous joints and begin with a calcareous portion. The end twigs are calcareous, often for a length of 18 mm.; they give off twigs and lateral twigs in which the horny joints are completely absent, and thereby the tender terminal twigs of the colony acquire a very fragile and brittle consistency.

The spicules of the coenenchyma form three-sided and irregular longish scales, with sharply toothed and incised edges, covered with numerous sharp spines. There are also spindles with pointed warts. They hold firmly together by means of the toothed edges. Their length to breadth in mm. reaches 0.15–0.03; 0.1–0.06.

In the polyps the spicules form eight regular vertical rows of broad, flat, strong scales, convex in accordance with the periphery of the polyp, strongly toothed and covered with pointed warts. Their height to breadth in mm. reaches 0.05–0.2; 0.05–0.15; 0.03–0.12. The scales lie upon a support of bent, thorny spindles of 0.08 mm. length, which form eight longitudinal rows. The tentacle scales are broad, unsymmetrical, in three rows.

*Habitat*.—Station 320, off the Rio de la Plata; depth, 600 fathoms; bottom, green sand.

4. *Primnoisis ambigua*, n. sp. (Pl. IX. fig. 9).

The colony is upright, bushy, expanded above, the branches spreading out prevalently in one plane.

The main stem is upright, bent towards several sides in its course. From its base upwards it gives off branches at acute angles, some of which have the stoutness of the main stem and others are weaker. During their much twisted upward course the branches ramify more and more abundantly, and send their fine terminal branches right to the top of the colony.

The twigs, which arise from the branches at moderate intervals from one another, are long and slender and give off fine lateral twigs, which but rarely again bear twigs of the fourth order. The branches arise from the stem and the twigs from the branches, mainly on four sides, but two branches, arising opposite to one another, are always more strongly developed and ramify more in one plane, so that the colony acquires a somewhat bilateral appearance. The terminal twigs arise from one or two sides.

The height of the colony reaches 140 mm. The thickness of the main stem near the base is 3 mm. The length of the fine terminal branches is up to 11 mm., mostly 10 mm.

The coenenchyma is only preserved in the terminal twigs and some of the larger branches. On the latter it is thin and transparent, on the thin twigs thick, and thickly covered with polyps, which stand around the twig in spirals, each composed of four polyps.

Towards the base of the twigs the polyps are more scattered and on the thick branches only sparsely strewn, at wide intervals from one another. Their form is club-shaped. On the twigs they are directed obliquely upwards. Their length reaches 0·8 to 1 mm.

The axis exhibits proportionally short, calcareous joints, which are cylindrical and longitudinally fluted. The jointing can be followed even into the finest branches, the points of which are always formed of a short, calcareous joint. In the stem the calcareous joints have a length of 2·5 to 4 mm.; the horny joints of 0·5 to 1 mm. The branches arise from the calcareous joints, but not so regularly as in the foregoing species. Many calcareous joints in the stem and branches give off no twigs. Very often only one branch arises from a joint, then two, seldom three. The branches and twigs commence usually with a horny joint. If the branch arises near the upper end of the calcareous joint, then the horny base of the branch comes into contact with the horny joint of the stem, hence many branches and twigs thus apparently arise from the horny joints of the stem.

In the twigs the calcareous joints are longer than in the stem or in the thicker branches, and measure from 4 to 5 mm.

The spicules of the coenenchyma are less differentiated from those of the

polyps than in the foregoing species. They are longish plates, with very strongly toothed edges and prickly surfaces. Their length to breadth in mm. reaches 0·28–0·1; 0·17–0·05; 0·13–0·05. In the calyx there are transversely placed plates, with sharp, bent, sometimes branched teeth on the edge, which interlock closely on opposite sides. Height to breadth in mm.—0·1–0·16; 0·12–0·2; 0·07–0·2. The calices have hence a roughly prickly surface.

This species leads the way to *Mopsea* through the formation of its axis and spicules.

*Habitat*.—Kerguelen Island; depth, 10 to 80 fathoms.

## Genus 2. *Mopsea*, Lamouroux.

*Mopsea*, Lamx., Hist. des Polyp. corall. flexibles, p. 465, Caen, 1816.

Colony branched, generally in one plane. The cœnenchyma is relatively thick, transparent only on the lowest part of the stem. The polyps are closely crowded on the stem and branches in short ascending spirals, so that at times they appear to form whorls. They are club-shaped and directed obliquely inwards towards the branches. The tentacles are not retractile, but in repose bend themselves together inwards over the oral region. The axis consists of short calcareous and horny joints. The branches originate with a horny joint from the calcareous joint of the stem, but many arise so near to the edge of the calcareous joint that, owing to their growth in thickness, the horny joint of the branch comes into contact with that of the stem and the branch appears to arise from the horny joint. The spicules of the cœnenchyma are finely spined, unsymmetrical scales, which are strongly toothed at the edge, where the teeth of adjacent plates interlock. In the polyps the plates are scale-like, placed peripherally, and cover the polyp in the same manner as the tentacles. They have a strong, convex curvature on the surface, which corresponds to the arching of the body of the polyp, and sharp thorns on the outer surface.

The genus *Mopsea* was first founded by Lamouroux.<sup>1</sup> His diagnosis is:—"Polypier dendroïde, à rameaux pinnés, écorce mince, adhérente, couverte de mamelons très-petits, allongés, recourbés du côté de la tige, épars ou subverticillés." To this genus he refers *Mopsea verticillata* = *Mopsea encrinura* (Ehren.), and *Mopsea dichotoma* (Linn.). For these two also the diagnosis is quite correct. Ehrenberg (Corallenthiere d. rothen Meeres) adopted the genus, but modified the diagnosis in such a way that he set forth as the most important character the origin of the branches from the horny joints. This led him to refer to the genus a Melithæidean, *Mopsella erythræa*. Milne-Edwards (Hist. Nat. des Corall.) follows the precedent of Ehrenberg. Thenceforth the position of the genus *Mopsea* became greatly involved. Gray wrongly identified a Melithæidean with *Mopsea dichotoma*, Lamx., for which he creates a new genus, *Mopsella*, while he will

<sup>1</sup> Loc. cit.

recognise the retention of the genus *Mopsea* only for *Mopsea encrinula*.<sup>1</sup> Kölliker in his *Icones Histiologicæ* apparently did not examine the typical *Mopsea encrinula*, and only had Gray's *Mopsella dichotoma* and Ehrenberg's *Mopsea erythræa*, before him, which he united with a new species under *Mopsea*. He refers *Mopsea* to the Melithæidæ and is therein followed by Klunzinger, who again only had *Mopsea erythræa*, Ehrenberg, before him.

It seems strange that de Blainville<sup>2</sup> should not allude to this genus, though he visited Caen in 1829 to examine the types of Lamouroux' species.

The Challenger material contains both the species upon which Lamouroux founded his genus, and supported thereby it is possible to restore the genus to its old condition. The two forms which belong thereto are true Isidæ; the calcareous joints of their axis consist of concentric lamellæ with deposits of calcareous crystalline bodies. They retain their essential form after treatment with acids. Together with the two new genera *Primnoisis* and *Acanthoisis* they form a well-defined subfamily of the Isidæ, that of the Mopseinæ, which are closely connected with one another through the form of the polyps and of the spicules.

1. *Mopsea dichotoma* (Linné) (Pl. IX. fig. 10).

*Isis dichotoma*, Linn., Syst. Nat., Ed. x. p. 799.

„ „ Lamk., Hist. anim. sans vert., t. ii. p. 302.

*Mopsea dichotoma*, Lamx., Hist. polyp. flexibles, p. 467.

„ „ Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 197.

*Non Mopsella dichotoma*, Gray, Proc. Zool. Soc. Lond., 1857.

*Nec Mopsella dichotoma*, Verrill, Bull. Mus. Comp. Zool., 1864, p. 38.

*Nec* „ „ Kölliker, Icon. Histiol., p. 142, pl. xix. fig. 41.

Stem upright, ramified; the main stem, rising from a calcareous disk-like base, gives off slender branches on two sides at different heights, which again develop lateral twigs in similar manner. These are long and rod-like, and, arising at acute angles, soon turn upwards and rise parallel to one another to about the same height. In this way twigs are formed up to the fifth order. Since the twigs, arising from the stem or branches, soon attain to nearly the same thickness, and the latter, at the origin of each branch, is somewhat bent out of its straight course in the opposite manner, there arises the appearance of a continuous dichotomy. The main stem, in the largest specimen, has a diameter of 2 mm. at the base, and a height of 165 mm. The rod-like, unbranched, terminal branches, may develop to a length of 95 mm.

On the lower part of the stem the cœnenchyma is thin and allows the jointed axis to show through, on the branches and twigs it becomes thicker and filled with polyps. These, as Lamouroux has already asserted, are different on the thicker parts of the stem and on the branches. On the thin branches they are projecting, club-shaped, with

<sup>1</sup> Proc. Zool. Soc. Lond., 1857, p. 283.

<sup>2</sup> Manuel d'Actinologie, 1834.

truncated mouths, they are directed upwards and bent towards the stem. Their length reaches 0·6 to 0·7 mm. They stand in not very distinct spirals, still not so closely crowded as in *Mopsea encrinula*. At the apex of the twigs they arise only from two sides alternately. On the thicker twigs they still stand in spirals, but the individual polyps are smaller and stand at wide distances from one another; on the stem they are still isolated, but in part can still be recognised as projecting papillæ. Accordingly, on the older part of the colony degeneration of the polyps appears to take place.

The horny joints of the axis are, in the lower part of the stem, longer than the calcareous joints, but soon become shorter, and already in the stem the calcareous joints become double their length. In the branches and twigs the calcareous joints are more than four times as long as a horny joint. In the stem the calcareous joints are slightly compressed in one plane and distinctly fluted longitudinally; sometimes the ribs between the longitudinal furrows show sharp indented edges.

The branches sometimes arise from the middle of the calcareous joint, more frequently from the upper edge, where their first horny joint fuses with the horny joint of the axis.

The spicules in the cœnenchyma are prickly, lancet-shaped, often curved plates, with strongly toothed edges and with sharp warts on the surface; they are thickly placed and give the surface of the cœnenchyma a rough appearance. Length to breadth in mm.—0·22–0·05; 0·12–0·08; 0·16–0·1; 0·2–0·07; 0·18–0·06.

In the polyps the plates became strong scales convexly bent on the surface, whose lower edge is incised and whose toothed upper edge is overhung by sharp spines. Height to breadth 0·08–0·16; 0·07–0·15; 0·05–0·22 mm.

Colour in alcohol, yellowish-white.

This species is excellently characterised by Lamouroux, and after his well-defined characterisation of the genus it is not well possible to confuse it with a Melithæidean. He gives the diagnosis as follows:—"Rameaux grêles, cylindriques, presque filiformes, avec dichotomies à chaque articulation; polypes mamilliformes dans les rameaux supérieurs, tuberculeux dans les moyens, superficiels dans les inférieures; écorce unie sur la tige." The original specimens of Lamarck's *Isis dichotoma* in the Zoological Museum at the Jardin des Plantes, Paris, agrees in all particulars with our specimens, and it still has the original label attached to it, with the name written thereon in Lamarck's handwriting.

Gray's *Mopsella dichotoma* is, on the other hand, a Melithæidean, as is sufficiently evident from the description, and this is confirmed by Verrill when he says:—"I am unable to find any generic differences between this species and those subsequently referred by him to Melitella."

*Habitat*.—Port Jackson, Australia; depth, 35 fathoms. Three specimens.

The Indian Ocean is given by Lamouroux as the place where the species was found.

2. *Mopsea encrinula* (Lamarck) (Pl. VII. figs. 1, 1a, 1b; Pl. IX. fig. 11).

*Isis encrinula*, Lamk., Hist. anim. sans vert., t. ii. p. 302.

*Mopsea verticillata*, Lamouroux, Hist. Polyp. flexibles, p. 467, pl. xviii. fig. 2, et Expos. méth., p. 30.

*Mopsea encrinula*, Ehrenberg, Corallenth. d. rothen Meeres, p. 131.

The colony is upright, ramified, the branches expanded in one plane. The main stem gives off from two sides, alternating, plume-like twigs, which remain simple, on a few larger branches which again bear plume-like twigs on two sides; since the larger lateral branches of the stem attain to the thickness and nearly to the length of the main stem, and as the finer plumes come off at angles of  $35^{\circ}$  to  $40^{\circ}$ , the whole colony acquires a fan-like appearance.

Length of the main stem 200 mm. Thickness at the base 2 mm. Length of one of the two main branches 145 mm. Length of the feather-like branches 20 to 25 mm.

The cœnenchyma is thick, not transparent. The polyps are closely crowded on the stem and twigs. On the stem and larger branches they are more developed on the sides where the branches arise and leave the intervening cœnenchyma free; on the twigs, on the contrary, they are arranged in close spirals. Each spiral is formed of five polyps, but the spirals follow so close upon one another that each, on superficial examination, looks like a whorl. The polyps are club-shaped, 1 mm. long. Their form very strongly recalls that of the polyps of the Primnoids, with which they agree in being able to bend themselves in towards the stem, as is always the case in death. The closed tentacles form over the calyx an obtuse cone which recalls the closed operculum of the Primnoids. The axis consists of horny and calcareous joints, which latter exhibit distinct longitudinal furrows. In the lower part of the axis the horny joints are larger than the calcareous joints. In one example the axis is horny up to 8 mm. above the base, further towards the point the calcareous and horny joints become of equal length, and soon the calcareous joints exceed the horny ones in length by more than double.

The branches and plumes arise on both sides of the stem alternately, for from every joint a twig comes off, on the one joint always from one side and on the next from the opposite side. The first joint of the branch or twig is horny and arises from the calcareous joint of the stem, but frequently close to the upper edge, so that its horny base fuses with the horny joint of the stem or branch. This occurrence is very frequent, and gave rise to the diagnoses of Ehrenberg and Milne-Edwards, that the branches and twigs arise from the horny joints.

In one specimen, in the collection of the Jardin des Plantes, Paris, the origin of several branches from the calcareous joints is easy to be seen.

The spicules of this species are rough and thorny, those of the cœnenchyma are longish lancet-shaped plates with sharp interlocking teeth on the edge. Length to breadth in mm.—0.1–0.05; 0.14–0.06; 0.13–0.05; 0.12–0.05; 0.1–0.03.

In the calyces these spiny scales are arranged transversely around the periphery, and form new areas of spiny scales, each scale with concave deeply-toothed lower edge and convex upper edge, over which spines project. These scales are bent on the surface so as to correspond to the curvature of the body wall. Height to breadth in mm.—0·05–0·18; 0·07–0·14; 0·07–0·1.

The scales of the tentacles are similarly formed, and spiny.

Colour in spirit, yellowish-white.

This species was first described by Lamarck, and has been very well figured by Lamouroux.

*Habitat*.—Station 162, off East Moncœur Island, Bass Strait; depth, 38 fathoms; bottom, sand and shells. Three specimens.

The specimen in the Jardin des Plantes in Paris was collected by Peron and Lesueur from Australia.

During the voyage of the "Gazelle" one example was obtained off the north-west coast of Australia from a depth of 50 fathoms.

### Genus 3. *Acanthoisis*, n. gen.

Colony branched, the ramification takes place in one plane, plume-like. The cœnenchyma is relatively thick and allows the jointed axis to show through only at the beginning of the stem. The polyps are arranged in close spirals on the stem and branches. They are cylindrical and upright, arising with broad bases, evenly truncated at the end. The tentacles are short, not retractile; in repose they bend together inwards over the opening of the calyx from their origin, so that they lie horizontally over the opening of the calyx and close it. The points are then bent inwards and the pinnules folded in, forming an eight-rayed star.

The axis consists of horny and calcareous joints, of which the calcareous joints in the stem are about twice as long as the horny ones. The branches on both sides arise from the calcareous joints, but sometimes so high up that the first horny joint of the branch at the same time touches the horny joint of the stem. This relation, however, only occurs in the older, thicker branches. The calcareous joints exhibit deep longitudinal furrows, which are separated from one another by sharp longitudinal ribs. The edge of each rib is split into sharp teeth, which stand upright in the middle of the joint, but at the two ends are bent towards these. The deep furrows between the ribs are partially filled, with warty, spindle-shaped spicules, which accompany the longitudinal canals. The overlying cœnenchyma contains longitudinally placed, flat, longish calcareous bodies with strongly toothed edges, unsymmetrically shaped; in the polyps these calcareous bodies become larger and broader, and are deposited peripherally in the body wall with the toothed edges interlocking. In the tentacles similarly formed calcareous bodies are



developed. This genus stands very near to *Mopsea*; the spicules closely resemble those of *Mopsea dichotoma*, but, apart from the different habit of the colony, the polyps show a totally different form, and most of the branches arise from the middle of the calcareous joints.

As yet only one species can with certainty be referred to this genus. Perhaps also the *Mopsea costata* from the London clay, cited by Milne-Edwards and Haime,<sup>1</sup> belongs to it.

*Acanthoisis flabellum*, n. sp. (Pl. VIII. figs. 1, 1a, 1b; Pl. IX. fig. 12).

The colony is expanded like a fan, and plumosely branched. The main stem gives off larger branches and smaller twigs alternately on two sides, which come off nearly at right angles. The small twigs generally remain simple, the larger branches bend round after a short course and run parallel to, or at sharp angles with the main stem, themselves again branching further just like the latter, bearing partly larger twigs, which again give off lateral twigs, and partly small unbranched twigs that stand out at right angles. Twigs of the fifth order may thus be developed. Only in individual places do two branches anastomose with one another, most of them are free. Superficially regarded, we have a number of radiating branches diverging in one plane, which are provided with two rows of twigs like a feather. The main stem has a diameter of 1.5 mm. at the base and a length of 95 mm., the larger branches attain a length of 80 to 90 mm., the smaller branches 5 to 10 mm. The entire height of the colony reaches 110 mm., the greatest breadth 100 mm.

The polyps are placed on the stem and branches in short spirals, four or five in a spiral; only on the thin, somewhat flattened, terminal twigs are the polyps placed on both sides of the axis. A short process of the coenenchyma forms the end of each twig. The polyps are shaped like truncated cones. They arise with broad bases and diminish slightly in size towards the mouth, which appears to be evenly truncated, since the tentacles are folded in at right angles over the oral cavity. The polyps stand up straight from their axis; only on the point of the twig are they placed obliquely to the stem. Their height reaches 0.4 mm. and the diameter at the base 0.5 mm.

The axis consists of alternating joints of thick calcareous substance and intervening masses of horn. In the thicker parts of the stem the calcareous joints are twice as long as the horny joints, 3 mm.; in the branches and especially in the terminal twigs they become considerably longer than the horny joints, which have a much smaller diameter than the calcareous joints. The latter have a spindle-like form. The last joint is always calcareous. In the stem the calcareous joints are whitish, in the twigs they assume a reddish-yellow colour. The branches arise from each calcareous joint to the number of two, at different heights, from each side. Sometimes the first horny joint of the higher

<sup>1</sup> Monogr. British Fossil Corals, p. 42, pl. vii. fig. 3.

branch comes into contact with the horny joint of the stem, and then appears to arise from the latter. The longitudinal furrows on the calcareous joints are deep and bounded by sharp ribs, which have serrated edges. On the smaller branches the distance between the individual teeth reaches 0.12 mm., and they project 0.04 mm. above the edge.

The spicules of the cœnenchyma consist of a deep layer of spiny spindles, which follow the longitudinal canals in the furrows, 0.2 to 0.21 mm. in length, and 0.02 to 0.03 mm. in diameter; and a superficial layer of flat, often slightly curved, spiny bodies, whose edges interlock, and which cover the cœnenchyma thickly. They are prolonged up the wall of the polyp in which they are placed peripherally from its base upwards. Their form closely resembles that of the spicules of *Mopsea*. The upper edge is convex, strongly toothed, the lower edge somewhat concave, with projecting, finely toothed lobes, the surface spiny.

Spicules of the cœnenchyma, length to breadth in mm.—0.16–0.05; 0.15–0.05; 0.15–0.06. The spicules of the polyps measure 0.06–0.16; 0.05–0.18; 0.07–0.22; 0.07–0.25 mm. The spicules of the cœnenchyma and of the polyp-wall are coral red. The spicules of the tentacles are shaped like those of the polyp-wall, only somewhat more slender and a little more spiny on the surface; their colour is white. Height to breadth, 0.05–0.12; 0.05–0.13 mm. The colour of the whole colony is a brick-red, the polyp mouths white.

*Habitat*.—Port Jackson; depth, 30 to 35 fathoms.

### Family III. PRIMNOIDÆ, Valenciennes (*s. str.*).

*Primnoaceæ* (*pars*) Valenciennes, Comptes rendus, 1855, t. xli. p. 7.

*Primnoaceæ* (*pars*), H. Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 138, 1857.

*Primnoadæ*, Gray, Proc. Zool. Soc. Lond., 1857, p. 285; *op. cit.*, 1859, p. 483.

*Primnoaceæ* (*pars*) (as a division of Subfamily Gorgoninæ), Kölliker, Icones Histiol., Abth. 2, 1865, p. 135.

*Primnoidæ* (*pars*), Verrill, Rev. Polyps East Coast N. Amer., Mem. Bost. Soc. Nat. Hist., vol. i., 1884, p. 8; Trans. Conn. Acad., vol. i., 1869, p. 418.

*Primnoadæ* (*pars*) + *Calligorgiadæ* (*pars*) + *Calyptraphoridæ*, Gray, Cat. Lithophytes Brit. Mus., 1870, pp. 43, 34, 41.

*Primnoadæ* (Subfamily), Studer, Monatsber. k. d. preuss. Akad. d. Wiss. Berlin, 1878, p. 641.

*Primnoidæ* (*emend.*), Verrill, Bull. Mus. Comp. Zoöl., vol. xi. p. 28, 1883.

When Milne-Edwards, following in the steps of Valenciennes, established the family *Primnoaceæ*, for that group of Gorgonids in which the sclerenchyma was much more developed on the bodies of the polyps than on the axis, and in which the polyps were prominent, he adds—"Mais cette disposition n'appartient pas seulement aux *Primnoacées* et se retrouve chez plusieurs *Gorgoniacées*, notamment chez les *Eunicées*; et ce qui distingue essentiellement ces deux agèles entre eux, c'est la structure du sclérénchyme

dont le tissu est lisse ou subéreux chez ces derniers, tandis qu'ici il est hérissé d'une multitude de petites pointes, formées, soit par des sclérites squamiformes, soit par des épines naviculaires." Dr. Gray excluded the forms with fusiform or spiniform scales, and in this he has been followed by Professor Verrill, who says he would include in Primnoidæ "only those genera in which the spicules of the cœnenchyma and calicles are scale-like and the axis more or less calcareous at least on the main stem," thus excluding Muriceidæ. With this decision we agree, but the discovery of forms among the family Isidæ with scale-like spicules leaves this character no longer solely characteristic of the Primnoidæ, and the absence of the otherwise very diagnostic opercular scales in the new genus *Primnoides* also excludes this otherwise fairly constant character from being one of family value.

The diagnosis of the family may be as follows:—Axis calcareous, flexible or rigid, simple or branched. Polyps prominent, arranged either alternate, opposite, in spirals or verticils on the axis. Cœnenchyma of the axis thin, with scale-like spicules. Polyps with scale-like or annular spicules. Tentacles completely retractile, in most with a series of several (mostly eight) triangular scale-like spicules, closing over the tentacles and forming an operculum—or the scales of the base of the tentacles of the polyp forming a quasi operculum over the infolded tentacles (*Primnoides*).

The family may for convenience be divided into the following four subfamilies:—

1. Callozostroninæ.—Axis flexible. Polyps prominent, with well-marked opercular spicules.
2. Calyptrophorinæ.—Axis rigid. Polyps prominent, with large annular body-spicules and with opercular spicules.
3. Primnoinæ.—Axis rigid. Polyps prominent, with scale-like spicules and with well-marked opercular spicules.
4. Primnoeidinæ.—Axis rigid. Polyps prominent, with scale-like spicules but with no opercular spicules.

#### Subfamily 1. CALLOZOSTRONINÆ.

This subfamily is established for a deep-sea species, with a flexible, feebly calcareous axis, around the greater portion of which the very prominent polyps are arranged in a bilateral manner in tightly packed rows of twelve or more. The naked space of the axis, caused by the divergence of the polyps, forms a narrow ridge extending along almost the whole length of the axis up to the very apical region, where the polyps budding from a central stolon-like mass are at least temporarily arranged in complete verticils. As no basal portion was dredged, it is impossible to be sure whether the colony was rooted or free. The spicules are scale-like. The tentacles are retractile and covered by a variable number of opercular scales.

Genus *Callozostron*,<sup>1</sup> Perceval Wright.*Callozostron*, Perceval Wright, Narr. Chall. Exp., vol. i. p. 691, 1885.

In addition to the characters of the subfamily, of which this is the only genus, the coenenchyma is thin and covered with large scale-like spicules; owing to the extreme crowding of the polyps on the axis, this is chiefly to be seen on the ventral ridge-like portion of the colony, from which the polyps diverge. The polyps are encased in several (six to seven) rows of imbricated scales, the last row of which, below the opercular scales, consists of four to eight scales which are furnished with very long spines. These form a pre-opercular calyx.

*Callozostron mirabilis*, Perceval Wright (Pl. X. figs. 1-5; Pl. XX. fig. 1).*Callozostron mirabilis*, Perceval Wright, Narr. Chall. Exp., vol. i. p. 69, figs. 234, 235, 1885.

The axis in the imperfect specimen dredged of this deep-sea form is about 280 mm. in length, it is extremely flexible, and nearly 20 mm. in widest diameter. The colony strongly reminds one at first sight of some gigantic Annelid. The axis is feebly calcareous, consisting of a central portion around which are a variable number of canals, apparently corresponding to the number of polyps around the axis. These canals vary in size, the smaller being on the dorsal aspect of the axis, *i.e.*, that portion opposite to the space free of polyps, and where the younger polyps are. The central portion of the axis appears in thin sections, which have been decalcified, to be altogether calcareous, while the rest of the axis is membranous, with calcareous, amorphous particles interspersed. Around the large canals numerous nutrient canals form a network. The polyps are very prominent, from 6 to 7 mm. in height from their base where it joins the axis to the tip of the epicalycine spicules. They are about 1.5 mm. in diameter, which is nearly the same throughout. The body of the polyp is completely encased in rows of imbricating scaly spicules. The tentacles are completely retractile, and covered with six to eight overlapping scale-like spicules, the outer row have frill-like everted edges; below these are four to six triangular scale-like spicules, with apices projecting in the form of very long spines, forming a pre-operculum. The polyps increase by lateral budding, so that they are in clusters of from one to four.

In the coenenchyma the spicules are flat, scale-like, some angular, others orbicular, some few flat spindles; all of the spicules are serrated on their edges, and are tuberculated.

Measurements, 0.404-0.504; 0.306-0.602; 0.602-0.4; 0.804-0.708; 0.704-0.8; 0.6 by 0.4 and 0.4 mm.

The spicules of the polyps are scale-like, tri- and quadrangular, sometimes slightly

<sup>1</sup> κάλλος, ζῶστρον.

orbicular in form; they are finely serrated on their edges, and are tuberculated all over; the tubercles radiating from a nucleus, which is either central or excentric; they are large, those of the body measuring 1 to 1 by 0·80 by 0·75 mm. The row of subcalycine spicules are triangular in shape; the apices prolonged into long spines; some of the largest measure 1–0·5 mm. across the base, with 1 mm. in length to base of spine; the total length including the spine varies from 4 to 4·5 mm. The triangular portions are tuberculated as in the other spicules, but the spines are smooth, circular on section, and hollow. The opercular scales are of an isosceles-triangle shape, more serrated at the base than on the longer sides; sometimes winged, measuring 1·50–1·75; 1–1·50 mm.

It seems probable that this species lived prostrate in the mud, and possibly there may have been some power of expansion and contraction in the colony. It is evidently closely related to *Primnoa*. It was dredged in the most southern station reached by the Challenger.

*Habitat*.—Station 153, near the Antarctic Sea (the most southerly dredging during the cruise); depth, 1675 fathoms; bottom, blue mud.

#### Subfamily 2. CALYPTROPHORINÆ.

In 1870 Dr. Gray<sup>1</sup> established a family “Calyptraphoridæ” for his genus *Calyptraphora*. While there can be no doubt as to the form for which the family and genus were intended, it would be impossible to identify the species from the diagnosis of either. In several respects *Calyptraphora* is related to such genera of the next subfamily as *Calyptrinus*, *Stachyodes*, &c. The very remarkable annular form assumed by some of the spicules of the bodies of the polyps will, however, with certainty distinguish it; indeed the presence of these scales with their broad and deep dorsal surfaces, and their equally broad but narrow ventral surfaces, will mark out the species of this genus from all other Primnoids.

The colony is branched in the one plane. The axis is hard, calcareous.

Polyps in whorls. The cœnenchyma of the axis is thin, with large irregularly shaped calcareous spicules, slightly overlapping. The second and third series of spicules on the bodies of the polyps are annular. The dorsal portions (mandral) of each are broadly expanded, forming a protective and defensive covering to the polyp. The tentacles are retractile, and the opercular scales are well marked.

<sup>1</sup> Cat. Lithophytes Brit. Mus., p. 41.

Genus *Calyptrophora*, Gray (*emend.*).*Calyptrophora*, Gray, Proc. Zool. Soc. Lond., p. 25, 1866.

,, Gray, Cat. Lithophytes Brit. Mus., p. 41, 1870.

,, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 642, 1878.

This genus was established in 1866 by Dr. Gray on "a small fragment" from Japan of a Primnoid Alcyonarian. The polyps had been almost all rubbed off from the axis, and the few that remained had been dislocated. As might have been anticipated under these circumstances, the diagnosis of the genus was very incomplete, and although the description of the genus in 1870 was altered from that originally given, and the species described by Pourtales as *Primnoa trilepis* was included therein, yet the diagnosis was in no way emended, and the description of the axis of the polyps and the spicules is incorrect and misleading. The species from Japan, of which there is no doubt Dr. Gray had an "eroded" specimen before him while writing his description of *Calyptrophora japonica* (this is still in the British Museum), is now, however, to be found in most large collections of Alcyonaria under Dr. Gray's name, and it would, therefore, serve no useful purpose to alter the generic or specific name.

Axis branched, sometimes branches are unilateral, other times irregularly dichotomous. The coenenchyma of the axis is thin, the spicules are large, irregular in form, tightly fitting over the surface or overlapping. The axis is hard, horny, consisting of bundles of fibrillæ penetrated with amorphous calcareous particles, and the surface when bare of coenenchyma has a wavy iridescent appearance. The basal portion is densely calcareous, with a central fibrous core, and the outer ring is striated.

The polyps are arranged on the axis in whorls of four, five or more. The body of the polyp is protected by three series of scale-like spicules of great size, of which the second and third series consists each of a single broad and hollowed ring-like scale (annular spicules). Opercular scales, eight in number, closing over the retractile tentacles.

The spicules of the body of the polyps will be found extremely characteristic of this genus as emended.

1. *Calyptrophora japonica*, Gray (Pls. XII., XX. fig. 4).*Calyptrophora japonica*, Gray, *loc. cit.*, p. 25, et *loc. cit.*, p. 41.,, ,, Studer, *loc. cit.*, p. 642.

The specimen in the collection, which appears to correspond to Dr. Gray's type, was taken off the Fiji Islands. The basal portion of the axis is present as a dense calcareous knob, about 6 mm. in diameter; at 70 mm. in height the axis divides into two main branches; each of these gives origin to a number (sixteen or more) of slender twigs, which are all unilateral, apparently the result of a unilateral dichotomy. The first twig, after

attaining a length of about 130 mm., twice dichotomizes. There is a pretty regular series of intervals of 10·50 mm. between the side twigs; the diameter of these twigs tapers from 1 mm. to the thinness of a hair. The total expanse of the fan-shaped colony is about 450 mm. at its widest portion. The axis is brittle.

When the drawing on Pl. XII. was made, the remainder of the branches had not been found, but this description is taken from the specimen as complete.

The cœnenchyma on the axis is thin, but covered with a single layer of large, irregular, thickened oblong or triangular scale-like spicules, which are proportionally denser on the younger portions of the twigs.

The polyps are in verticils of threes, fours and fives, with the tentacular region looking upwards and inwards towards the stem; there is an interval of about 3 mm. between the verticils. The polyps are (contracted) about 5 mm. long by 2 mm. wide at the basal portion. At the base of each polyp the large spicules of the axis seem to form a bilateral collar, under cover of which is inserted the first large horned annular spicule, which, broadly expanded on the dorsal aspect, completely surrounds the lower part of the body of the polyp; beneath this is a second large annular spicule with many spines, and with the ventral portion, larger than in the former spicule, it is apparently joined by fibre to the former, within which it is movable. These spicules do not present an appearance of being lateral spicules joined together. The opercular spicules are eight in number and form a complete operculum over the tentacles. The six opercular spicules nearest the dorsal aspect of the polyp are larger and more perfect than the two on the inner or ventral aspect; they are keeled and slightly overlap each other when closed.

Spicules.—Those of the cœnenchyma are scale-like but various as to shape; the oblong forms measure 2–0·5; 1–0·5; 1·5–0·75 mm. Those at the base of the polyps are oblong, curved, forming a collar, and measure 1·75 by 0·75 mm. The two-horned annular spicule forming the second row measures from base to extremity of spine 3 mm., with a broad diameter of 1·5 mm. The second annular spicule is 3 mm. (to end of spines) by 1·75 mm. in the expanded portion, and 1·50 mm. in the narrowed or neck-like part. The opercular spicules of the outer row measure 1–0·5; 1·25–0·75; 1–0·75 mm., and are triangular in form with broad bases. Of these the outer four seem to fit closely together when the tentacles are withdrawn, they then slightly overlap and lie almost against the main stem or its branches. In shape they are not unlike the petals of a Crucifer, the claw broadly expanded, the blade deeply pinched in. The spicules are in general punctate all over.

This species, originally described from Japan, has been found off Bourbon (Paris Museum, 1862; in this specimen the polyps are very small, 2 mm. by 1 mm.), and is now described from the Southern Pacific (Fiji).

*Habitat*.—Station 174c, of Kandavu, Fiji Islands; depth, 610 fathoms; bottom, Coral mud.

2. *Calyptrophora wyvillei*, Perceval Wright (Pl. XIX. figs. 2, 2a; Pl. XX. fig. 5).

*Calyptrophora wyvillei*, Perceval Wright, Narr. Chall. Exp., vol. i. p. 690, 1885.

Axis dark brown, shining, hard, striately furrowed in the only example found, branches unilateral. Polyp in dense verticils almost touching each other, oral opening downwards. The scales at base of the polyps form a well-marked collar, but the true body-spicules are of the type characteristic of the genus. The first ring-like spicule is sometimes furnished with two blunt spines and at other times it has four to five irregular spinous projections. The second spicule is constricted in the middle, and has either a simple waved outline on its free margin or projects in spines. The opercular spicules are very much larger than in *Calyptrophora japonica*.

The spicules of the coenenchyma are irregular shaped, flattened, scale-like, translucent, the dark brown axis showing through them; they measure 2.50–0.75; 1.5–0.50; 0.75–0.50 mm. The spicules nearest the base of the polyps are larger, and curved, generally one at either side of the polyp. These measure 2–1; 1.75–0.75; 1.50–0.50 mm.

The first annular spicule is distinguished by two long spines. This spicule measures on an average of several polyps 3–1.50; 2.75–1.50 mm., the spines vary in sharpness, and are sometimes bifid.

The second annular spicule when lying on its dorsal surface reminds one of a little basket with a handle across it; it is slightly constricted in the centre, the free surface is waved, not spined as in *Calyptrophora japonica*; it measures 2 by 1.50 mm. The opercular spicules vary, the outer six being larger and more calcareous than the inner two; they are triangular in form, with broad bases, and blunt to sharp apices, the outer ones are slightly folded or keeled, and project beyond the second of the body spicules when the polyp is withdrawn. They measure 1.40–1; 1.50–0.75; 1.25–0.50 mm. In all the spicules the surface is pustulate, sometimes assuming quite a frosted appearance.

This interesting species, of which only a fragment of a stem about 90 mm. in height was found, seems sufficiently distinct from *Calyptrophora japonica*.

*Habitat*.—Station 171, north-east of the Kermadec Islands; depth, 600 fathoms; bottom, hard ground.

## Subfamily 3. PRIMNOINÆ.

Colony simple or branched. Polyps in whorls or spirals on the stem or branches. Axis rigid, horny, calcareous. The spicules of the coenenchyma are scale-like. Those of the polyps are very varied in form, but are referable to the same type. The opercular spicules are well marked.



Species belonging to the following genera are found in the collection :—

- |  |                                 |
|--|---------------------------------|
| 1. <i>Calypterinus</i> , n. gen.               | 5. <i>Amphilaphis</i> , n. gen. |
| 2. <i>Stachyodes</i> , n. gen.                 | 6. <i>Plumarella</i> , Gray.    |
| 3. <i>Stenella</i> , Gray ( <i>emend.</i> ).   | 7. <i>Caligorgia</i> , Gray.    |
| 4. <i>Thouarella</i> , Gray ( <i>emend.</i> ). | 8. <i>Primnoella</i> , Gray.    |

Genus 1. *Calypterinus*,<sup>1</sup> n. gen.

Axis simple, consisting of a horny matrix, largely filled with calcareous particles. Polyps arranged in regular verticils on the axis, of from five to seven each; at each verticil a portion of the axis is free from polyps, but the large wing-like calcareous spicules of the lateral polyps overlap and form a circular opening, which runs in a direct line all along that portion of the axis which is free from polyps. The polyps are thus in a measure bilaterally arranged. The basal portion unknown, but it would appear as if the polyps in this genus opened with their oral region looking downwards.

*Calypterinus allmani*, n. sp. (Pl. XI. figs. 1, 1a; Pl. XIV. fig. 5; Pl. XX. fig. 2).

This species is represented in the collection by two specimens of about 100 mm. in height. In the more perfect specimen, the axis towards the apparent basal portion is brittle and hard, 1 mm. in diameter, somewhat more horny and less calcareous towards the apex, but always leaving a well-developed horny matrix when treated with an acid. The cœnenchyma of the axis is thin, with large, oblong, minutely tuberculate, scale-like spicules, which allow the iridescent axis to be seen through them. The polyps are arranged in a bilateral manner on the axis, in verticils of from four to seven each; judging of the basal and apical portions of the axis by their hardness, it would seem that the polyps look downwards, but they appear to have in common with many of the members of the subfamily a power of folding themselves inwards on the axis. The polyps are 3 mm. in height, with a diameter of 1 mm. The intervals between the verticils of polyps varies, being sometimes not appreciable, and at other times it is about 1 mm. The spicules on the body of the polyp are arranged in three series—not counting a few small scales connecting the body of the polyp to the main axis; the first row consists of two large scales, wing-like, one overlapping the other at its base. In the case of the lateral polyps in each verticil, one of these scales from either polyp forms part of the arch of the tunnel, which runs in a direct line along the main axis; these scales measure about 2 mm. in length, and about 2 mm. in the widest part. These spicules will be best understood on reference to Pl. XIV. fig. 5, where the figure 5

<sup>1</sup> καλ.υξ, πτέρινος.

is placed in the centre of the tunnel. The second row consists of two scale-like spicules which tightly embrace one-half of the body of the polyp, the everted edges are triangular in shape, these measure about 1.5 mm. in length by 1 mm. in width. The third row also consists of two scales about 1 mm. square, with everted frill-like margins. All these three series are doubtless movable on one another. The opercular series of from six to eight triangular-shaped scales are remarkable, in that those nearer the axis are less calcareous and less fully developed than the outer ones, so that this portion of the polyp is, when in a fully expanded condition, nearly naked.

The spicules of the cœnenchyma are oblong thickened scales, arranged side by side, not imbricated, very feebly tuberculate or granular (tubercles or granules striate), sometimes slightly irregular branched. Measurements, 1.3–0.2 mm. in narrowest and 0.302 in broadest end; 0.804–0.3; 0.4–0.106; 1.204–0.404; 0.402–0.102; 0.402–0.1 mm.

The spicules of the polyp bodies are very irregular in form. Those of the two adjoining lateral polyps on each whorl have been already referred to. They are in shape somewhat like the clawed petal of a pink, and in the drawing (Pl. XIV. fig. 5) are seen in profile. The blade or expanded portion is 2 mm. broad by 1 mm. deep, and the claw-like part is 1.5 mm. long; it is placed at an angle to the blade, but its base is nearly as broad as the broadest part of the blade. The outer spicules of the inner polyps are much smaller and less winged. Some of the opercular spicules are triangular and keeled, others are folded on themselves. When they, on the withdrawal of the tentacles, approach one another, the larger and outer four fall over the inner series and become themselves slightly imbricated like the petals in a papilionaceous corolla. The larger opercular scales measure 1–0.5; 1.3–0.6 mm. The polyp tentacles have some needle-like spicules, about 0.3–0.02 mm.

This remarkable form, in the peculiar bilateral arrangement of its whorls of polyps upon the main axis, recalls to some extent *Callozosteon*.

*Habitat*.—Reefs, Fiji. (This is almost certainly a deep-sea form.)

## Genus 2. *Stachyodes*,<sup>1</sup> n. gen.

Axis sparingly and dichotomously branched, consisting of a dense horny matrix, with calcareous particles intermixed in the older portions, highly iridescent. Polyps in closely arranged verticils, about five in each verticil, tentacles retractile, when retracted the opercular scales touching the basal scales of the lower row of polyps. Polyps with oral region opening downwards. Spicules of the bodies of the polyps in three series of two each, the spicules of each series either touching each other or overlapping, and symmetrical.

<sup>1</sup> σταχυώδης.

*Stachyodes regularis*, n. sp. (Pl. XI. figs. 2, 2a; Pl. XX. fig. 3).

Several fragments of this species were dredged near the Kermadec Islands. Two of these are branched. The axis on the largest of the specimens is 140 mm. in height, and about 1.5 mm. in diameter, horny, but with calcareous particles, highly iridescent and grooved. The branches are perfectly dichotomous. The coenenchyma on the axis is thin, but covered with thickly set narrow scale-like spicules, the larger of which are 1.5 mm. long by 0.5 mm. wide; these form a well-marked layer and are intercalated one with the other. The basal portion is unknown.

The polyps are in close verticils of fours or fives, looking downwards, and with an interval between the polyp whorls of about 1 to 0.5 mm. The full-grown polyps measure about 3 mm. in height by 2 mm. in width. The body, or rather the dorsal or outer surface of the body of the polyp is enveloped by three series of scale-like spicules, which, when the polyp is retracted, just overlap one another. The first series consists of two broad, somewhat quadrilateral, hollowed-out scales, 1.5 mm. by 1 mm., jagged at their edges, and with a prominent projection; the sides of these scales slightly overlap each other, the projecting portion extends along and around either side of the polyp. The second series normally consist of two, but sometimes of three scales, smaller than those of the first series, somewhat quadrilateral, but not flat, about 1 mm. by 1 mm., the edges slightly overlapping, sometimes only touching. The third series of scales also consists of two, each of these is broader than the spicules of the second series, being 2 mm. in width. The series of opercular scales is eight in number, and consists of triangular-shaped scales, each deeply keeled, and projecting beyond the last series of the body scales. The scales of the inner or ventral surface are sometimes either feebly or non-calcareous, and the outer of the opercular scales, these just below the third series of body scales, are the largest.

A few irregular-shaped scale-like spicules are to be found on the ventral or inner surface of the body of the polyp.

The colony increases by apical growth of the whorl of polyps, and also by budding; these buds arise in whorls below and between the whorls of adult polyps, and by their intercalary growth, the main axis increases in thickness.

Spicules of the coenenchyma irregular in shape, scale-like or even flattened spindles, measuring 1.50–0.50; 1–0.25; 1.45–0.45; 0.90–0.12 mm.

The opercular scales measure 1–0.50 mm.; at base 1–0.45 mm.

*Habitat*.—Station 171, off the Kermadec Islands; depth, 600 fathoms; bottom, hard ground.

This interesting form shows near affinities to the genus *Calyptrophora*, but differs in the spicules of the body of the polyp. To this genus will possibly belong

*Calyptrophora josephinae*, Lindström,<sup>1</sup> with the polyps bent downwards. It is also possible that *Primnoa regularis*, Duchassaing and Michelotti,<sup>2</sup> not only belongs to this genus, but an inspection of the remains of the original specimen in the Turin Museum makes it just possible that *Stachyodes regularis* equals *Primnoa regularis*. For this species Dr. Gray has made the genus *Narella*,<sup>3</sup> and places it between *Stenella* and *Primnoella*. The definition is, however, unintelligible, and is certainly not diagnostic of the species from Guadeloupe. Dr. Studer emended the diagnosis of Dr. Gray's genus, and included in it two new species,<sup>4</sup> which would not be included in *Stachyodes*. Dr. Kölliker includes *Primnoa regularis*, D. and M., among the species of *Primnoa* as diagnosed by him,<sup>5</sup> and, from the measurement of the spicules of the polyp given by him, these would in the form from the Atlantic indicate a smaller species than the one now described from the Pacific Ocean.

### Genus 3. *Stenella*, Gray (*emend.*).

*Stenella*, Gray, Cat. Lithophytes Brit. Mus., p. 48, 1870.

This genus was established by Dr. Gray for *Primnoa imbricata*, Yate Johnson. A comparison of the type species shows that it has very close affinities to *Thouarella*, which was established by the same author for *Primnoa antarctica*, Val., and it is possible that a more extended knowledge of the species will result in the two genera being merged into one. For the present the arrangement of the polyps on the branches will serve as a convenient distinction. In *Stenella* they are opposite and in whorls, in *Thouarella* they are alternate and arranged in spirals. The axis is hard, in a young stage horny, fibrous, but soon becomes dense with calcareous material; under the cœnenchyma it is often highly iridescent. The base, so far as known, is attached by a calcareous disc to Corals or stones. The axis is feebly or much and irregularly branched. The cœnenchyma is thin, with large disc-like spicules, often deeply concave with turned up edges, and attached to the cœnenchyma by the central concave portion. In an attached specimen a thin layer of cœnenchyma with spicules spreads over the Coral to which the *Stenella* axis adheres. The polyps are large, prominent, in whorls of two or four. The bodies of the polyps are enclosed in several rows of large, imbricating scale-like spicules, of which the row (preopercular) just below the opercular scales, forms a more or less complete investing calyx. The opercular scales are eight in number, symmetrical, and fold completely over the retracted tentacles. Sometimes they form a conical and projecting, at other times a more or less flattened operculum.

<sup>1</sup> K. Svensk. Vetensk. Akad. Handl., Bd. xiv. No. 6, p. 6, 1877.

<sup>2</sup> Duchassaing et Michelotti, Mém. sur les Coralliaires des Antilles, p. 17, pl. i. figs. 12, 13.

<sup>3</sup> Cat. Lithophytes Brit. Mus., p. 49.

<sup>4</sup> Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 643.

<sup>5</sup> Icones Histologicæ, p. 135, 1865.

1. *Stenella johnsoni*, n. sp. (Pl. XIII. fig. 3; Pl. XX. fig. 6).

Axis attached to Corals, irregularly branching, branches at wide intervals, and irregularly dichotomous. The only specimen dredged is about 200 mm. in height. Older portion of a dense horny and calcareous structure; younger portions horny, feebly calcareous. Cœnenchyma thin, with large scale-like spicules, often imbricated, and varying in size and outline, through which the axis is seen. At the base of the polyps the spicules are large and concave, partially surrounding the opercular scales.

Polyps in whorls of two. Polyps about 2.5 mm. high by 1.5 mm. at widest diameter. The large scale-like spicules which surround the body are in about three rows, overlapping at their edges; the row immediately below the opercular spicules consists of four large spicules, the free edges of which form a deep frill around the polyp. Opercular scales eight in number; when closed the summit of the operculum scarcely projects beyond the margin of the cup-like frill formed by the last row of body spicules. The spicules on the body are symmetrical.

The spicules of the cœnenchyma measure 1.0-0.75; 1.25-0.50 mm.; those on the polyps 1.50-1; 1-1 to 1.25-1 mm. (just below opercular scales). The opercular scales 0.50-0.45 mm.

Of this species parts only of one specimen were obtained; these were very much damaged by the tangles getting intertwined with them. It is nearly related to *Stenella imbricata*, Yate Johnson, but is easily to be distinguished by the form of the opercular scales, which in the species from Madeira form a projecting cone over the retracted tentacles.

*Habitat*.—Station 344, off Ascension Island; depth, 420 fathoms; bottom, hard ground.

2. *Stenella gigantea*, n. sp. (Pl. XIV. fig. 4; Pl. XX. fig. 8).

Axis in the only specimen found, about 520 mm. long and 2 mm. in diameter. Slightly curved, dense, brittle, the horny fibres being largely loaded with calcareous matter. Very slightly grooved, iridescent. The cœnenchyma is thin, with a dense layer of large irregularly quadrilateral spicules, which form quite a crust around the axis. The polyps are in whorls of four each, about 10 mm. apart. The polyps are large, from 6 to 7 mm. in height, and about 3 mm. in widest diameter. The large scale-like spicules that surround the body of the polyp form about four rows, of which the fourth or pre-opercular row is formed of four large scales, forming a calyx, within which are the very prominent projecting opercular scales; these latter are deeply keeled. On the side of the body of the polyp, next to the axis, a few small, circular, scale-like spicules are found.

The spicules of the cœnenchyma measure 2 mm. by 1 mm. Of those on the body of

the polyp, the pre-opercular measure 2 mm. by 2 mm., and those of the operculum 1.5 mm. by 1 mm.

*Habitat*.—Station 174, August 3, 1874; lat. 19° 10' S., long. 178° 10' E.; depth, 210 to 610 fathoms.

This species is described from a single specimen, in which, however, several of the whorls of polyps are quite perfect. The polyps are the largest of any of the hitherto described species of this genus.

3. *Stenella dæderleini*, n. sp. (Pl. XX. fig. 7).

Axis in the several fragments found irregularly branched, hard, brittle, of a dark-brown colour, iridescent; the outer horny fibres give it a striated appearance. Some of the fragments are from 100 to 150 mm. in height, and in their widest diameter about 2 mm.

The cœnenchyma is very thin, with a layer of semitransparent scale-like spicules, many of which have a projecting central knob, giving a thorny appearance to the layer.

The polyps are in whorls of three or four each, at irregular distances on the stem and branches. The polyps are long, narrow, about 3.5 mm. in height by 1 mm. in width.

The scale-like spicules surround the body of the polyp in about four series, while the pre-opercular calyx is formed of eight scales with spathulate prominences. The opercular scales, eight in number, project far from the pre-opercular ring, and each spicule is folded back on itself with a broadly laminated free edge.

The spicules of the cœnenchyma measure 1-0.50; 0.50-0.25; 0.25-0.12 mm.; those of the polyps 1-0.50; the pre-opercular scales 1.50-0.50; 1.50-0.45 mm., and those of the operculum 1-0.50 mm.

The remarkable projecting knobs from the elongated scale-like spicules will distinguish the species from all others as yet described.

*Habitat*.—Station 237, south of Japan; depth, 1875 fathoms; bottom, blue mud.

4. *Stenella spinosa*, n. sp. (Pl. XIII. figs. 1, 2; Pl. XX. fig. 9).

Axis branched, 130 to 150 mm. in height, branches arising irregularly and somewhat densely from the main axis, so as to give the shape of a small bush to the colony, dark-brown in colour, deeply striated, cœnenchyma thin, on the older portion with a dense compact layer of small, overlapping, scale-like spicules, through which the dark axis is plainly visible; on the younger portion the scales are larger and imbricated. The polyps on the main stems and larger branches arise single and in an irregular fashion, but on the younger twigs in whorls of twos and fours.

The polyps measure 3 mm. in height by 2 to 2.5 mm. in width across the pre-opercular scales. The body of the polyp is surrounded by four rows of scales below the

pre-opercular series ; of these several in each row project with spathulate free edges. The pre-opercular layer is formed of eight large spicules with deeply hollowed spathulate free edges, which united form a frilled edge around the opercular scales, which latter are eight in number, each deeply folded on itself, the whole not projecting much beyond the limits of the pre-opercular calyx.

Spicules.—Those of the cœnenchyma measure 0·6–0·4 ; 0·5–0·20 ; 0·2–0·2 mm., of the polyps, 1·1–0·6 ; 0·7–0·8 mm., and of the operculum 0·9–0·6 ; 0·7–0·4 mm.

*Habitat*.—Station 145A, off Prince Edward Island ; depth, 310 fathoms ; bottom, volcanic sand.

#### 5. *Stenella acanthina*, n. sp. (Pl. XIV. fig. 3 ; Pl. XX. fig. 10).

Axis consisting of a main stem, around which numerous branches are arranged in an incomplete spiral. Main axis in one specimen 390 mm. long, the side branches tapering from 50 mm. near the base to about 25 mm. near the summit. The axis is hard, brown in colour, about 4 mm. in diameter at base, consisting of numerous concentric twigs of fibrous substance, with calcareous particles. The nutrient canals form a row of tubes around the outermost layer, over which is a moderately dense cœnenchyma, in which numerous oval disc-like spicules are often very densely packed.

The polyps are small, in whorls of threes or fours, about 2 mm. in height by 1·25 mm. at widest diameter. The spicules on the body of the polyp vary greatly in size, those on the side nearest the axis being markedly smaller, and enabling the polyp to be folded in on itself ; four series of spicules between the base of the polyp and the pre-opercular layer can be made out. The pre-opercular layer consists of three large acutely spined spicules.

Spicules.—Those of the cœnenchyma measure 0·302–0·204 ; 0·108–0·104 ; 0·1–0·1 mm. ; those of the polyps, 0·8–0·6 ; 0·7–0·5 ; 0·702–0·604 ; the pre-opercular, 1·5–0·705 ; 0·9–0·504 ; 0·706–0·2 ; and those of the operculum, 0·7–0·304 ; 0·4–0·2 ; 0·502–0·2 mm.

*Habitat*.—Station 320, off the Rio de la Plata ; depth, 600 fathoms ; bottom, green sand.

#### Genus 4. *Thouarella*, Gray (*emend.*).

*Thouarella*, Gray, Cat. Lithophytes Brit. Mus., p. 45, 1870.

Gray's diagnosis of the genus is as follows :—"Coral simple, with long, simple, filiform branches, spreading on all sides of the stem. Bark formed of large imbricate scales. Polype-cells smooth, bell-shaped, scattered on upper side of branches, covered with four or five series of imbricate scales."

The genus was made for one species, *Primnoa antarctica*, Valenciennes. The characters

given above fairly agree with this species, with the exception of the distinction of a simple corallum. Since the only example hitherto known is a fragment, no conclusion as to the entire colony could be drawn from it. *Thouarella antarctica*, Val., is represented in the Challenger collection, but there is also a series of nearly related forms, which constitute, with the first species, a genus for which the name *Thouarella* may be retained. The diagnosis of the genus has had, however, to be essentially modified.

The colony consists of a main stem, which is generally simple, seldom divided into several branches, which then lie in one plane. From the main stem are given off twigs in different directions, generally in threes, which come off at successive heights at nearly right angles. They are always much thinner than the main stem, and either remain simple or give off twigs, as does the main stem. The polyps are large relatively to their support, club- or cup-shaped, and are arranged on the twigs in short, ascending spirals of three polyps each, seldom opposite. The cœenchyma of the stem and twigs is thin, and contains an outer layer of flat, scale-like, calcareous spicules, which overlap one another at their edges, and below this there are small triangular or polygonal scales. The calyx scales are different on the dorso-lateral and on the ventral sides of the bilateral calyx. The dorso-lateral scales have strong, convex upper edges, towards which the little prominences, radiating from the nucleus, diverge. Frequently the prominences fuse, and then form continuous ribs which terminate in projecting teeth at the edge of the scale, often the middle tooth of the uppermost row of scales is especially prominent, at times forming a long spine. The ventral scales are only in one case similar to the dorsal ones, otherwise they are small, thin plates, which generally form two longitudinal rows, and which, on the ventral curvature of the calyx, may overlap one another with their edges. The upper scale is then overlapped by the upper edge of the one next below it.

The operculum is formed of eight pointed curved scales, convex towards the outer side, which laid together form a low cone. In the middle line on each opercular scale is found a deep longitudinal furrow. When closed the lateral edges do not touch one another but leave eight radial slits between.

The growth of the stem and the development of the twigs takes place at the apex of the colony, while at the same time the twigs at the base of the colony die off. A single polyp forms the origin of the new twig. The base of the polyp elongates like a peduncle, in which a thin axis is developed. First of all two new polyps bud forth on the peduncle, which appear to be arranged in a short spiral. This mode of growth also takes place in those forms which bear polyps arranged oppositely on the end of the twig.

The genus *Thouarella* comes nearest to *Stenella*; the first species to be described, *Thouarella moseleyi*, exhibits in the form of the calyx and in the structure of the colony a close relationship to this genus, and may be regarded as an intermediate form.



*Thouarella hilgendorfi* seems to connect this species with the true forms of *Thouarella*, of which *Thouarella antarctica* may be regarded as a type. So far the species of the genus have only been found in deep water in the southern hemisphere.

1. *Thouarella moseleyi*, n. sp. (Pl. XIV. figs. 1, 1a; Pl. XXI. fig. 2).

The stem is upright, and from it twigs come off only in two directions. The twigs are thin, flexible, and generally simple, seldom bearing lateral twigs. The stem is clothed with a thin cœenchyma, which contains two layers of calcareous spicules, the outer of large flat scales and the inner of triangular or polygonal spicules. The polyps are placed partly on the main stem between the points of origin of the lateral twigs in an irregular row, and partly on the twigs. They are large as compared with the thickness of the twig. On the base of the twigs they are arranged in short spirals of up to three, further on oppositely. The polyps are covered with five transverse rows and four longitudinal rows of large scales; the scales of the ventral side are slightly different from the others. The operculum is in the form of a low cone.

The whole habit of the colony reminds one very much of *Stenella*; the colony does not yet show the typical growth of the other species of *Thouarella*. It is a form which effects a transition between the former genus and the typical forms of *Thouarella*. The little upright colony is 90 mm. high; the axis is thin, slightly calcareous, and flexible, somewhat flattened. At the base 1 mm. in diameter. The colour is yellow and the surface shining. The bark contains two layers of calcareous scales, an outer one of irregular, four- or five-sided calcareous scales, which overlap each other at their edges, and a lower layer of small, triangular or irregularly polygonal spicules. The twigs arise from the stem at different heights, alternating in two rows. This condition appears at first sight very different from that of the typical *Thouarella*, but on more careful examination the arrangement of the twigs here also falls under the law given in the description of the genus. Between two twigs, which are given off on two sides at different heights, one polyp is placed on the stem in such a way that the two twigs are arranged in a short spiral with the polyp; at a few points a short twig is developed in place of the polyp. The twigs are generally simple, 0.5 to 0.6 mm. thick, and 15 to 20 mm. long. In one place the twig has developed into a branch 35 mm. long, which bears lateral twigs and polyps in the same way as does the main stem.

The polyps are club-shaped, their length reaches 1.5 mm. They are placed on the stem in the first mentioned order, as well as on the twigs. Here they show at the base the typical arrangement in short spirals of three, further up two calyces always draw near together, so that at the end they are placed opposite. On quite young twigs from the apex of the colony one sees the young buds arising at the base of the first developed polyp in the spiral.

The scales of the calyx have a convex upper edge which is slightly toothed, usually a middle tooth and two lateral teeth are especially developed, more particularly in the uppermost rows. There are five transverse rows of scales present, of which one is ventral. The ventral scales are slightly different from the dorsal ones in size; their lateral edges are covered by the lateral scales; the lower one always covers with its upper edge the base of the next above it, so that the scales can slide over one another when the calyx is bent ventrally.

The opercular scales are short, spear-shaped, with the dorsal and ventral symmetrical, the lateral unequal sided, all grooved in the middle line with expanded base, the lower edge of which is finely toothed. They form, when laid together, a short, obtuse cone.

Scales of the calyx with rough, radially arranged spines, convex upper surface, which is toothed; nucleus central with regard to the arc of the upper edge. Length to breadth—0·2–0·25; 0·15–0·2; 0·23–0·27; 0·23–0·26 mm.

Opercular scales; base of the triangle to height—0·3–0·12; 0·32–0·2; 0·38–0·2 mm.

Scales of the cœnenchyma; upper layer, nucleus excentric. Length to breadth—0·36–0·15; 0·2–0·17; 0·23–0·27; 0·2–0·2 mm.; lower layer—0·1–0·1; 0·12–0·1 mm.

*Habitat*.—Station 171, off the Kermadec Islands; depth, 600 fathoms; bottom, hard ground.

## 2. *Thouarella hilgendorfi* (Studer) (Pl. XXI. fig. 4).

*Plumarella hilgendorfi*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 648, Taf. ii. fig. 15.

According to the mode of development of the lateral twigs and the form of the calyx scales, this species may be best placed in the genus *Thouarella*. This is especially evident from the Challenger specimens, in which the stem is less branched than is the case in the Japanese specimens. In one specimen the stem rises from a flat, expanded, basal, calcareous lamella. Already at a distance of 2 mm. above its root it forks into two equal branches, which rise up parallel with one another to the same height and bear the lateral twigs, without themselves further bifurcating. In a second colony the main stem gives off from either side lateral branches, which both lie in one plane.

The stem is horny, calcareous, rigid, in all cases oval in transverse section, so that the longer axis is parallel to the direction of the lateral branches. The larger transverse section of the stem near the base reaches 2 to 3 mm. in diameter. The axis is hard, brittle, brown in spirit, in dried specimens more yellowish; the surface has a slight golden glitter. Parallel furrows traverse it longitudinally. The twigs are thin, flexible, at the beginning only 0·5 mm. thick. They arise from three sides of the stem at different heights, and stand off from the stem at nearly right angles. Their points of origin are very close to one another, so that, when superficially examined, they appear to form

whorls. Their length reaches 30 to 40 mm. In most cases they are simple, they sometimes give off a lateral twig near the base. The calyces are club-shaped, 0·8 to 0·9 mm. long. They are isolated on the main stem, especially towards the point; they are more closely placed on the twigs.

In the first description of the species, from a dried example, it was stated that the calyces arise oppositely in pairs, so that two cells always stand off in a different plane from the two preceding and the two succeeding ones. A fresh examination of the original, with the assistance of the Challenger specimens, shows the condition to be somewhat different. The calicles form around the stem spirals of three, so that the fourth calyx always comes to stand over the first again. But thereby the second is so near to the first and the third to the fourth in its origin, that in many places the calyces appear to stand opposite.

On the outside the calyces are covered with large scales, which form six to eight transverse rows and five longitudinal rows. The scales of the last row bear strong, projecting spines, which extend beyond the opening of the calyx.

The operculum forms a low cone of eight pointed spear-shaped scales, which are toothed on their lateral edges.

The spicules of the cœnenchyma are longish and oval, their lower edge is always covered by the upper edge of the preceding scale.

The form and size of the spicules in the Challenger specimens agree completely with those of the original type.

Scales of the calyx.—The calyx scales of the uppermost row exhibit a convex upper edge, over the middle of which a rough spine rises. The scale without the spine has a length of 0·2 mm., a breadth of 0·15 to 0·2 mm.; the spine projects 0·08 mm. beyond the scale. In the row next below this, the scales are relatively high, almost lancet-shaped, the upper edge pointed, 0·24 mm. high, and 0·2 mm. broad, with strong radial prominences, at the end with single short spines. The lower scales exhibit small prominences, and a smooth, convex upper edge, which is sometimes somewhat incised in the middle. Height to breadth, 0·16–0·21; 0·16–0·2; 0·12–0·19 mm. The opercular scales are broad and lancet-shaped, the lateral and ventral ones truncated at the end. Dorsal, height 0·24, breadth 0·1; lateral, height 0·24, breadth 0·1; ventral, height 0·13, breadth 0·04 mm. The scales of the cœnenchyma are inequilateral three-cornered or four-cornered plates, whose edges overlap one another on opposite sides. Height to greatest breadth, 0·2–0·16; 0·25–0·26; 0·2–0·18; 0·19–0·18 mm.; deeper layer, 0·09–0·07; 0·18–0·12 mm.

*Habitat*.—Station 192; off the Ki Islands, south of Papua; depth, 140 fathoms; bottom, blue mud.

Japan, collected by Dr. Hilgendorf; also collected by Dr. Döderlein.

3. *Thouarella köllikeri*, n. sp. (Pl. XXI. fig. 5).

A main stem, from which branches come off in different directions; these again bear lateral twigs on which the polyps are placed. The polyps are larger than in the preceding species, and the calyx scales of the last row are pointed and lancet-shaped. In the best-preserved specimen the main stem has a length of 150 mm., with at its base a thickness of 2 mm. Here also the transverse section is oval, and there is a spiral twisting.

The axis is in the lower part calcareous, brittle, and becomes softer and flexible towards the apex. From the stem, branches arise at different heights; these, as in the preceding species, come off in three directions. They are, however, differently developed; on one side they remain short, on the two other sides, at angles of about  $60^\circ$  to the first, they develop into long branches, which attain the strength of the main stem. At the same time they bend themselves away from the main stem, especially in one direction. Owing to this condition the colony attains a more bilateral structure; designating the side of the stem on which the short branches arise as dorsal, and the opposite side as ventral, then one can distinguish dorsal and ventro-lateral or side branches. The dorsal branches are always simple, 10 to 25 mm. long, flexible at the end, and directly bear the polyps. The lateral branches, on the contrary, attain a strength which, especially in the lower part of the colony, equals that of the main stem, and reach a length of 80 to 100 mm. They themselves ramify in a similar manner to the main stem, giving off dorsal and lateral twigs, which are generally soft and flexible, the lateral twigs may finally again bear lateral twigs, while here the dorsal ones are wanting; the dorsal ones are also wanting at the ends of the larger branches.

The polyps are placed on all the finer twigs, as in the foregoing species, arising in three directions at different heights, so that they surround the stem in short spirals. Their form is pear-shaped. There are eight transverse rows of scales present. These have a convex upper edge; the surface is provided with longitudinal ribs, diverging above, of which a middle one is the most developed; in the last row the middle rib is very strongly developed and projects at the end as a point, above the edge of the scale, which is higher than it is broad.

As in the preceding species five dorsal and lateral longitudinal rows of scales may be distinguished, and two ventral ones, which are thin, transparent and ribless. The opercular scales are strongly concave, the dorsal ones pointed, with serrated edges, the ventral ones small, scale-like, covered by the broad lateral ones.

Scales of the calyx.—The scales of the uppermost row are higher than they are broad, in the middle line there arises from the nucleus a greatly serrated keel, prolonged into a spine which projects beyond the edge of the scale, the lateral edges are finely toothed. Height to breadth, 0.62 to 0.54 mm.; the succeeding scales exhibit a strongly convex upper edge, which in the upper rows is still frequently drawn out in the middle into a

short point; moreover, there radiate from the nucleus to the edges raised ribs, formed from the fusion of prominences, which at the end run out into little points projecting beyond the edge of the scale. Height to breadth, 0·47–0·5; 0·42–0·57; 0·36–0·3; 0·42–0·35; 0·35–0·52 mm. The opercular scales are pointed, triangular, with somewhat unequal sides, with ribs radiating from the nucleus which run out into points, of these the middle rib is the most developed, and runs out into a long spine. Height to breadth, 0·7–0·27; 0·62–0·37; 0·5–0·38 mm.

The cœnenchyma scales of the outer layer are irregularly three-cornered or polygonal, at times four-edged or rounded, they always overlap one another with their lateral edges. Height to length, 0·41–0·26; 0·35–0·26; 0·43–0·3; 0·38–0·29; 0·4–0·25; 0·26–0·2 mm. Those of the inner layer are flat, three-cornered, or irregularly polygonal, 0·18–0·12; 0·15–0·09; 0·2–0·18 mm.

*Habitat*.—Station 308, off Tom Bay, Patagonia; depth, 175 fathoms; bottom, blue mud. Two specimens.

Station 310, Sarmiento Channel, Patagonia; depth, 400 fathoms; bottom, blue mud. A fragment of a specimen; the twigs are finer, more flexible, the dorsal twigs on the branches being hardly developed.

#### 4. *Thouarella antarctica* (Valenciennes) (Pl. XXI. fig. 6).

*Primnoa antarctica*, Valenc., Zool. du Voyage de la Frigate la Venus, Atlas, Zoophytes, pl. xii. fig. 2.

„ „ Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 140.

„ „ Gray, Proc. Zool. Soc. Lond., 1857, p. 286; 1859, p. 483.

„ „ Kolliker, Icones Histiol., p. 135.

*Thouarella antarctica*, Gray, Cat. Lithoph. Brit. Mus., p. 45.

Milne-Edwards characterises the species as follows:—“Polypiéroïde extrêmement délicat, dont les branches, presque filiformes, sont disposées irrégulièrement tout autour d'une tige principale, de façon à constituer une touffe en forme de goupillon. Papilles calicifères petites, mais très fortes, comparativement au diamètre de l'axe qui les porte.” The fragment figured in the Voyage of the “Venus” gives a good general idea of the specimen preserved in the Jardin des Plantes, only in detail the scales are drawn much too strongly toothed. Gray has made use of the figure and description for the characterisation of his genus *Thouarella*, without giving any further details. Kolliker gives the measure of the calyx scales examined by him from 0·18 to 0·63 mm. The species has nowhere been minutely described. The original specimen, in the collection of the Jardin des Plantes, was obtained by Captain Du Petit Thouars at the Falkland Islands. It is a branch, the lower part of which is broken off, and from which fine lateral twigs are given off on all sides, which bear the club-shaped polyps. The comparison with a bottle-brush (goupillon) is very striking.

The scales are relatively large. The upper row of calyx scales is higher than broad, with strong prominences, and a median keel which runs out into a short spine. Height to breadth, 0.54–0.42 mm.; the succeeding scales are broader than high, with small teeth on the upper edge, often interspersed with stronger teeth. Height to breadth, 0.42–0.5 mm.

The opercular scales are triangular, pointed, with median keel. Height to length, 0.5–0.3; 0.65–0.4; 0.43–0.2 mm. The scales of the cœnenchyma are irregularly triangular to four-cornered with unequal sides. Height to breadth, 0.46–0.35; 0.46–0.2; 0.3–0.25 mm.

Several specimens which were obtained by the Challenger may be referred to this species.

The generally simple stem rises from a flat, leaf-like, calcareous base, which covers stones, &c.

The axis is horny, calcareous, brittle, yellow, with a golden sheen on the surface. Its transverse section is oval and the whole stem is twisted in a long spiral. The length of the stem reaches 150 to 200 mm.; the thickness at the base 2 to 2.5 mm. The twigs, which arise from three sides of the stem in an ascending spiral, are generally simple, up to 25 mm. long, coming off from the stem at nearly right angles. Their axis is stiff and bristle-like. The club-shaped polyps have a length of 2 mm. There are seven transverse rows of scales present and eight longitudinal rows. The form and size of the scales agree completely with those of the type specimen.

Calyx scales.—Upper row with short spines. Height to breadth, 0.6–0.29; 0.61–0.3; 0.46–0.3 mm.; those of the following rows are broader than high, 0.37–0.75; 0.37–0.58; 0.3–0.4 mm. Scales of the cœnenchyma, 0.35–0.3; 0.4–0.26; 0.45–0.35; 0.25–0.2 mm.

*Habitat*.—Station 148A, off the Crozets; depth, 550 fathoms; bottom, hard ground, gravel, shells.

##### 5. *Thouarella affinis*, n. sp. (Pl. XXI. fig. 3).

Very like the preceding species. From the simple stem, which appears twisted in a long spiral, simple twigs come off, in ascending spirals, from three sides. These bear the polyps. The polyp calyces are 2 mm. long and contain scales, which are distinct from those of the preceding species in size and sculpture. The scales of the last row are not provided with spines but are simply toothed. The scales of the calyx are less prominent.

The specimen, broken into three pieces, has, from the base to the apex, which contains the summit of the colony, a length of 220 mm. The main stem, from which twigs come off along its whole course, has at the lower end a diameter of 2 mm. and

diminishes slowly towards the apex. The axis is, till near the apex, hard, brittle, of a horny yellow colour, on the surface with a golden glitter, iridescent, towards the apex it becomes quite soft and flexible. The transverse section is elongatedly oval. If one follows the longer axis of the transverse section along the course of the stem, one sees that as it proceeds further up the stem it undergoes a twisting, which at a fourth from the apex reaches  $360^\circ$ , so that the stem appears to be twisted in a long spiral, and thence commences a second spiral twist up to the apex. The stem is clothed with a very thin cœnenchyma, which contains a single layer of flat calcareous spicules.

The twigs come off apparently from all sides of the stem, at very blunt, almost right angles, and follow very close upon one another, so that the distance between two twigs reaches only 1.5 to 2 mm.; they are most thickly placed at the end of the stem. On a closer examination one sees that the twigs surround the stem in short spirals, so that the points of origin of four twigs always form an ascending spiral, thence it results that the twigs arise mainly from three sides of the stem. But since the stem itself is spirally twisted this condition is difficult to follow. The length of the twigs reaches 50 mm., their thickness at the base is only 0.5 mm.; their axis has, like that of the stem, an oval transverse section, is brittle at the commencement, but soon becomes soft and flexible. The twigs are generally simple, they sometimes fork, near their base, into two equivalent lateral twigs.

The polyp calyces are relatively large, 2 mm. long, and of pear-shaped form. The summit expanded and the base constricted. They arise on the twigs at varying intervals, but never in whorls or oppositely, they are most thickly placed on the ends of the twigs, the apices of which are generally occupied by a polyp. Usually the polyps are placed on the twigs, like those on the stem, in short spirals of always three to four calyces. The calyx scales are large, symmetrical, the upper edge convex, finely toothed, in the second uppermost row the middlemost tooth is somewhat lengthened, in the highest the scales are nearly lancet-shaped. There are seven rows of calyx scales one above the other, which are arranged in five dorsal and lateral rows. The ventral scales are smaller, more polygonal, in two to five longitudinal rows, of these the edge of the lower one always projects beyond the base of the next above. The opercular scales are eight in number, lancet-shaped, concave towards the outside; the ventral ones are a little smaller than the dorsal ones, but always more deeply placed.

New twigs and polyps arise on the end of the stem, so that here the growth is terminal. Under the apex of the stem, whose end is without cœnenchyma, one first of all finds several polyps, of which some are very much elongated, a thin horny axis projects into their base spindle-like, and small polyp buds arise. In other parts the formation of a small branch has already taken place, the terminal polyp is placed on a horny axis, on a long peduncle on which new polyps arise.

Calyx spicules.—Broader than long, slightly toothed on the edges, without prominent

ribs, but with large rough warts. Only those of the last row higher than broad, with longer teeth on the end. Height to breadth in mm.—0.42–0.33; 0.26–0.4; 0.24–0.46.

Opercular spicules.—Pointed, triangular, hollowed out in the middle line, with two lateral combs, 0.4–0.15; 0.33–0.15 mm.

Cœnenchyma—spicules of the upper layer, irregularly three- or four-sided. Height to breadth, 0.25–0.3; 0.3–0.47; 0.19–0.33; 0.3–0.22; 0.29–0.25 mm. Lower layer, irregularly polygonal with a few small warts, 0.28–0.28; 0.23–0.2; 0.3–0.16 mm.

*Habitat*.—Station 135D, off Inaccessible Island, Tristan da Cunha; depth, 55 to 70 fathoms.

#### 6. *Thouarella variabilis*, n. sp.

Main stem simple. The twigs come off from the main stem in three directions at nearly right angles, they are thin, flexible and frequently branched. The polyps are placed on the twigs in short spirals of always three in number. The calyces are cup-shaped, 2 to 2.5 mm. long, covered with only a few scales, forming four to five transverse rows. The scales of the uppermost row are produced into longer or shorter spines, which surround the calyx wall. The operculum consists of eight concave scales, which vary slightly according to position. When closed it forms a low, slightly projecting cone, the apex of which is generally overtopped by the spicular spines. The scales of the cœnenchyma are large, and their edges overlap laterally.

This species, of which there are numerous examples, varies to an extraordinary degree in the size of the calyces, the development of the spines, and the development of the colony, without it being possible thereby to sharply separate the individual forms specifically. Nevertheless one can generally distinguish the following three varieties from each another.

#### Var. *a*. *The type* (Pl. XIV. figs. 1, 2; Pl. XXI. fig. 1).

The commonest form. The main stem is simple and in the largest specimen attains a height of 300 mm. The base is wanting in all the specimens. The axis is in its lower part firm and brittle, and consists of a layer of concentrically placed, calcified horny lamellæ and a softer medulla; above, the axis becomes softer and flexible.

Its transverse section is elongatedly oval, the largest transverse diameter, in the largest piece, reaches near the base 3 mm., in the upper third 1.5 mm. The entire stem exhibits a spiral twisting round its axis. The colour is brownish-yellow. The cœnenchyma is very thin and contains only a single layer of thin calcareous scales. The thin twigs, all the way up, come off from the stem mainly in three directions, at



intervals of 1.5 to 2 mm., and always so that the origin of the fourth twig comes into line with the first, whereby a not very regular spiral is formed. Every twig gives off again lateral twigs, according to the same law, usually two or three, which form long rods, only in quite large specimens do the twigs develop to a considerable length, and again give off tripartite lateral twigs. In one case the main stem has died off and a branch has developed to the strength of the main stem with analogous ramification.

The length of the twigs reaches 50 to 150 mm., that of the simple lateral twigs 20 to 30 mm. The axis of the twigs is at the base hard and horny, calcareous, in the finer ramifications thin, horny and flexible. The polyps are placed on the thinner twigs, just as on the end of the stem, in short spirals of threes. They are cup-shaped with wide calyx opening,

The spicules form on the polyps three irregular dorso-lateral longitudinal rows, in four to five transverse rows. Those of the ultimate and penultimate rows bear long spines coming out from the upper edge, which are half as long as the calyx, and project far beyond its opening, and form a course of six or eight spines around it. The ventral scales are small, thin, little plates, standing in two irregular rows. The operculum is formed of eight fine, strongly bent, lancet-shaped scales, which on closure of the calyx leave longish gaps between them.

Several examples are attacked by a Chætopod, an *Aphrodite*, probably belonging to the group of *Hermadion*, Grube, which lives close to the stem between the points of origin of the twigs. Probably in consequence of the irritation thus caused, all the twigs on the attacked side are inverted.

*Habitat*.—Station 145A, off Prince Edward Island; depth, 310 fathoms; bottom, volcanic sand.

Var. *b. brevispinosa*.

The main stem is simple, the twigs, which come off from it according to the same law as in the preceding variety, are sparsely branched, at the most into three branches; many remain simple.

The polyps are placed on the twigs at wide intervals and their arrangement in spirals is less evident. The polyps are larger, club-shaped, 2.5 to 3 mm. long. The calyx scales form here also five longitudinal rows; those of the last two rows have, however, only short, flat spines, which in individual calyces are reduced merely to short thorny processes. The latter are elongated in the two upper rows and form a crown around the calyx mouth of eight flat spines, sometimes notched at the end.

*Habitat*.—Station 145A, off Prince Edward Island; depth, 310 fathoms; bottom, volcanic sand.

*Var. c. gracilis.*

A very elegant, finely ramified form. The stem is 140 mm. long and is thin and flexible; it has at the base a diameter of 1.5 mm.; at first firm and brittle, it soon becomes horny and flexible. The twigs have at the base a diameter of 0.5 mm. and soon give off lateral twigs, usually 2 to 3 mm. long. These are always simple, thin, their length reaching 10 to 15 mm. The twigs are developed to about the same extent throughout the whole colony, only towards the apex they are shorter, they come off symmetrically on the three sides, and are bent at the ends, so that the colony acquires quite the appearance of a plume.

The polyps are placed on the twigs in close spirals of threes, they are cup-shaped and 2 mm. long.

The scales of the calyx form five transverse rows, those of the last and last but one develop spines, which form a crown around the calyx mouth and may completely cover the opercular scales, yet they never develop to the length of those of the type.

Spicules.—Calyx scales large, those of the uppermost row, rhombic or triangular, with a long spine, which is the continuation of a median keel radiating from the nucleus and projecting from the scale. Height to breadth, 0.62 to 0.32, the spine takes up 0.25; 0.36–0.36 to 0.68–0.25 mm. The succeeding scales are broad, but possess also a median keel and a short serrated spine. Height to breadth, 0.5–0.42; 0.45–0.33 mm. The lowest scales are without the spine, but are strongly serrated on the upper edge, 0.33–0.5; 0.41–0.4 mm.

The opercular scales are small and high, triangular, deeply furrowed in the middle line. Height to breadth, 0.5–0.2 mm.

The scales of the cœnenchyma are in the upper layer irregularly polygonal to four-cornered, on the free edge sharply serrated, with an excentric, but sometimes a marginal nucleus. Height to breadth—0.37–0.4; 0.22–0.3; 0.25–0.31 mm. Those of the lower layer are thin lamellæ with fine warts, four-cornered or irregular, provided with processes 0.1–0.11; 0.1–0.14 mm.

*Habitat.*—Station 150, off Heard Island; depth, 150 fathoms; bottom, coarse gravel.

Genus 6. *Amphilaphis*, n. gen.<sup>1</sup>

Colony generally ramified in one plane. Branches dividing off from the main stem on two sides in alternating series; these either remain simple or give off simple lateral twigs. Branches as well as twigs run parallel to one another, coming off from the stem or the branches, at angles of about 45°. The club-shaped polyps arise at varying intervals from one another in the circumference of the stem, of the branches and of the twigs, originating mainly from four different sides of the periphery. The scales of the calyces

<sup>1</sup> ἀμφοί, λαρίζ, dividing into branches.

and of the cœnenchyma are stout and covered with strong prominences, which in the calyx scales are merged into ribs radiating from the nucleus to the upper edge, and there running out into spines. The operculum, formed out of eight scales, constitutes, when closed, a low, blunt cone. The cœnenchyma is thin, with two layers of calcareous scales. The growth is apical.

This genus exhibits in the form of the calyces and scales a relationship to *Thouarella*, from which, however, it is distinguished by the mode of ramification. This latter exhibits already the condition of *Plumarella*, in which, however, the calyces come off only from two sides of the twigs. The new genus may therefore be considered as a connecting link between *Thouarella* and *Plumarella*.

*Amphilaphis regularis*, n. sp. (Pl. XV. figs. 1, 1a; Pl. XXI. fig. 7).

The main stem gives off large branches on two sides, which bear parallel-running lateral twigs, as well as simple twigs.

The polyps, placed on the stem, branches and twigs, form irregular short spirals of fours, which arise at different heights from the four sides. The club-shaped calyces have a length of 1.5 to 2 mm., and contain seven or eight transverse rows of scales, which are arranged in seven longitudinal rows, of which the ventral row is formed of somewhat differently constructed thin scales. The operculum closes the calyx completely and consists of eight triangular calcareous scales, which vary slightly in size, and form when closed a blunt low cone. The calyx scales are thick, covered with large, rough prominences, and with teeth on their edges. The scales of the cœnenchyma are three-cornered, toothed on one side, and overlap each other with their lateral edges. They are slightly smaller than the calyx scales.

One large colony has grown up from a flat calcareous base on a *Lophohelia* and rises to a height of 25 cm., with a lateral expansion of 13 cm. The main stem is flattened; its larger diameter reaches at the base 4 mm., at a height of 60 mm., where it is broken off, 1.5 mm. Its axis is hard, brittle, of a yellow-brown colour, the cœnenchyma appears to have died off, the axis is covered with foreign bodies (*Palythoa*). Branches arise from both sides, at different heights, beginning at the base of the main stem, and, at their origin, attain to nearly the thickness of the main stem. They are flattened in the same plane as the main stem, the axis is at the commencement hard and inflexible, but becomes in its further course thin and flexible, and causes the summit to hang over to one side like the twigs of a weeping willow. The branches give off twigs in the lower part, again in the same plane as the stem gives off the branches; these develop simple lateral twigs according to the same law. The simple terminal twigs, coming off from their branches at angles of 45°, attain a length of 40 to 50 mm., and are always much thinner than their parent twig.

The polyps are club-shaped, 2 mm. long, they arise from four sides of the twig, and form together a short ascending spiral. These spirals, however, are not quite regular, sometimes only three polyps form the spiral, in other cases the spiral runs twice round the stem before the origin of one polyp comes into the same line again with the first. Growth takes place at the end of the branches and twigs in a manner quite analogous to that in *Thouarella*. The scales of the calyx are covered with rough prominences, which often run out into little spines. Those of the uppermost row are broad, with a toothed, convex, upper edge. In the middle line of the scale a keel runs out from the nucleus which is produced into a long pointed or toothed spine, the rough prominences are arranged radially from the nucleus to the edge, and sometimes become merged together into ribs and end in short spines. Length to breadth in mm.—0·37–0·3; 0·37–0·33; 0·3–0·2; 0·3–0·25. The next lower calyx scales are broader than high, a median rib, running out from the nucleus, is present, but the keel scarcely projects; on the other hand, lateral spines are well developed. Height to breadth in mm.—0·15–0·3; 0·26–0·33; 0·24–0·37; 0·2–0·23. Towards the base of the calyx the spines on the scales disappear. The ventral scales of the calyx are thin, cycloid, without prominent sculpture. The opercular scales are very like those of *Thouarella*; triangular, with a median longitudinal furrow, which produces a convex keel on the inner side of the calyx scale. The prominences on these scales also are developed up to the point, and the edges are toothed and provided with prominent spines. Height to breadth in mm.—0·46–0·25; 0·3–0·2; 0·33–0·2; the latter ventral.

The scales of the coenenchyma form a superficial layer of irregular, polygonal, or triangular plates, with marginal nucleus and toothed edges. The rough prominences often run out into sharp, short spines. Length to breadth in mm.—0·27–0·2; 0·18–0·3; 0·2–0·15; 0·2–0·17; 0·2–0·12. The deeper layer consists of small, generally cycloid, thin little plates with a more central nucleus and weaker sculpture, 0·1–0·08; 0·1–0·07; 0·1–0·1 mm.

A smaller colony of this species from the same locality, 150 mm. in height, shows some deviations from the form described. The main stem gives off near its base two main branches, which come up to the main stem in strength, expansion and ramification. Their twigs, however, do not come off in the same plane as those of the main stem, but in a plane perpendicular to that. This is caused by the fact that the flat main stem, and the branches, are bent in a spiral; by adjustment of the spiral the branches and twigs of the main stem and of the branches fall into one plane, which is identical with that of the larger diameter of the stem. The calyces in this form are somewhat smaller than in the foregoing, 1·5 mm.; still, according to the form and condition of the scales there is no necessity for specific separation.

*Habitat*.—Station 135A, off Inaccessible Island, Tristan da Cunha; depth, 75 fathoms; bottom, hard ground, shells, gravel.

Station 135c, off Nightingale Island; depth, 100 to 150 fathoms.

Genus 6. *Plumarella*, Gray.

*Plumarella*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 36.

*Plumarella*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1870, p. 648.

The genus *Plumarella* was established by Gray for *Gorgonia penna*, Lamk., a Primnoid from the neighbourhood of New Holland. The diagnosis runs, "Coral fan-shaped, forked, expanded, branchlets pinnate, opposite or alternate. Bark thin. Cells elongate, clavate, incurved, alternate, in two rows on each side of the stem. Axis continuous, stony."

Studer (*loc. cit.*) expanded the diagnosis in order to include in the genus *Plumarella hilgendorfi*, Stud., from Japan. This latter, however, on comparison with the greatly increased material now at command, must be relegated to *Thouarella*, and thus *Plumarella* is referred to in the sense used by Gray.

If we consider *Gorgonia penna*, Lamk., as the type of the genus, and as represented by a magnificent specimen in the Museum of the Jardin des Plantes in Paris, then we may include in the same genus several more species; thus *Primnoa pourtalesii*, Verrill, recently described by Verrill,<sup>1</sup> and a new species obtained by the Challenger, may be included. *Cricogorgia ramea*, figured by Milne-Edwards<sup>2</sup> but not described, seems to be identical with Lamarek's *Gorgonia penna*.

The stem is upright, greatly ramified in one plane, so that the whole colony acquires a fan-like appearance. The expression "forked" used by Gray regarding the stem is not correct. The stem does not undergo a dichotomous forking, but is produced continually, only it gives off occasionally from two sides lateral branches, which may attain the strength of the main stem, and at the point of departure of the branch from the main stem this latter generally undergoes a twist in the opposite direction. The same takes place with the twigs of the branches, and the impression of a dichotomy may thereby arise. The main stem, as well as the stouter branches, are always flattened in the same plane as that of the expansion of their twigs. The axis is brittle, calcareous; it first becomes softer and horny in the thinner twigs, yet it always maintains a relatively strong rigidity. Branches come off from two sides of the main stem in an ascending series, generally alternating; they are partly thin, rod-like, simple, partly strong, with flattened axis and branched. They run parallel to one another. The branches give off lateral twigs again in like manner, which are sometimes simple, sometimes again give off thinner twigs. The last twigs are thin, rod-like structures. The calyces are generally small, cylindrical, and arise in alternating series from the branches and twigs, generally at relatively great distances from one another. The calyx scales are thin, cycloid, with central nucleus, the prominences small, smooth, the edge finely toothed. The operculum

<sup>1</sup> Bull. Mus. Comp. Zool., vol. xi. No. 7, 1883, p. 28.

<sup>2</sup> Hist. Nat. des Coralliaires, Atlas, pl. B. 2, fig. 6.

consists of eight fairly equally developed triangular scales. The spicules of the cœnenchyma form two layers. The upper layer consists of flat, thin, oval scales, the lower of very thin, small, calcareous plates.

[*Plumarella penna* (Lamarck).

*Gorgonia penna*, Lamk., Hist. anim. sans vert., ii. p. 323.

*Primnoa* (?) *plumatilis*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 141.

” ” Kent, Monthly Micr. Journ., 1870, pl. xli. figs. 10–12 (figure of spicules).  
*Cricogorgia ramea*, Milne-Edwards, loc. cit., Atlas, pl. B.2. fig. 6.

*Habitat*.—Australia, Captain Baudin's Expedition, 1801.

*Plumarella pourtalesi*, Verrill.

*Habitat*.—Lat. 31° 48' 50" N., long. 77° 51' 50" W. (Verrill).]

1. *Plumarella delicatissima*, n. sp. (Pl. XVI. figs. 1, 1a; Pl. XXI. fig. 8).

Some fragments of a *Plumarella* show such specific differences from any known form that they necessitate the foundation for them of a new species, which may be described as follows:—

Colony exceedingly finely branched, the terminal twigs very thin, flexible. The small, cylindrical calyces are placed on two sides of the branches and twigs in alternating series, their length reaches 0·5 to 0·7 mm. The calyx scales form five longitudinal rows of thin, cycloid, calcareous bodies, which are wanting on the ventral side of the calyx.

The opercular scales form a blunt cone, which does not completely close the calyx opening.

The main stem, of which the base is wanting, is flattened in one plane; at its lower end the larger diameter reaches 2·5 mm. Its axis is hard, horny, calcareous, on the surface shining, with numerous longitudinal furrows. From two sides arise from it, in alternating series, small thin twigs, of barely 0·5 mm. diameter, and larger branches which have at the beginning a diameter of 2 mm. All these come off from the stem at an angle of about 40° and run parallel to one another.

At the point of origin of each twig the stem undergoes a slight twist in the opposite direction, whereby the stem acquires a zigzag outline. The small branches either remain simple or give off at most two or three lateral twigs, the large branches, on the contrary, ramify after the manner of the main stem; the same is the case with the larger secondary twigs of the latter, and so on, so as at length to give rise to a little shrub exceedingly finely ramified in one plane, the simple terminal twigs of which have a diameter of 0·3 mm. and a length of 15 to 30 mm.

The polyps, all with the ventral side pressed or applied towards the stem, are cylindrical, slightly expanded only at the mouth, 0·7 mm. long on the thinner twigs, 1 mm. on the branches; they are placed on the branches and twigs in two alternating rows, at moderate intervals, up to 1·5 mm., from one another. The scales are dorsal and lateral, arranged in seven to eight transverse rows and five longitudinal rows; the ventral side is destitute of scales. The obliquely truncated calyx mouth is protected by eight thin, triangular, opercular scales, of which the ventral ones are only a little shorter than the dorsal ones.

The calyx scales are generally roundish or nearly square, with a central nucleus, from which the small prominences extend outwards only a little beyond the half radius of the scale. The upper edge of the scale is finely toothed, fine striæ radiate from the nucleus to the edges. Length to breadth in mm.—0·12–0·17; 0·2–0·2; 0·12–0·13. The opercular scales are triangular, toothed lamellæ, truncated at the end, 0·2–0·18; 0·2–0·16 mm. In the cœnenchyma two layers of calcareous scales may be distinguished, which, in the stem, may be readily separated from one another. The upper layer consists of longish, oval lamellæ, which overlap one another with their lateral edges. On the side which comes under the edge of the overlapping scale they are provided with relatively strong teeth. The prominences on these scales are very small, in addition the fine radial striation may here also be recognised. Length to breadth in mm.—0·14–0·17; 0·1–0·17; 0·22–0·11; 0·2–0·13; the lower layer consists of very thin oval or irregularly toothed spicules, on which the prominences are only very weakly and sparsely developed. Length to breadth, 0·1–0·1; 0·11–0·07 mm.

In this species the new polyps are budded off from the inside of the base of an old polyp, and in process of time, owing to the lengthening of the internode between two polyps, they move away from the mother polyp. Thus the growth may here be designated as intercalary.

*Habitat.*—Station 307, off Port Grappler, Patagonia; depth, 140 fathoms; bottom, blue mud.

#### Genus 7. *Caligorgia*, Gray (*emend.* Studer).

*Callogorgia*, Gray, Proc. Zool. Soc. Lond., 1857, p. 286; *Ibid.*, 1859, p. 484.

*Calligorgia*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 35.

*Caligorgia*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss, Berlin, 1878, p. 645.

The genus *Callogorgia* was founded by Gray in the year 1857 for *Gorgonia verticillata*, Pallas. The diagnosis runs:—"Coral forked, fan-shaped; branchlets pinnate. Axis continued, stony, compressed. Bark thin, white, formed of flat angular imbedded granules. Cells in whorls of three, cylindrical, incurved, covered with small imbricate scales." The character of three cells in a whorl does not suit the single species which Gray arranged under this genus. In the year 1859 Gray (*loc. cit.*) further arranged the

following species under the genus :—*Prymnoa flabellum*, Ehb., *Primnoa gracilis*, Milne-Edw., and *Primnoa plumatilis*, Milne-Edw.

In 1870, in his Catalogue of Stony Corals, the name *Callogorgia* was changed by Gray into *Calligorgia*; a special genus, *Plumarella*, Gray, was founded for *Callogorgia penna* (*plumatilis*), and the genus *Calligorgia* was confined to *Gorgonia verticillata*, Pall., with which *Gorgonia verticillaris*, Esper., *Prymnoa flabellum*, Ehb., *Prymnoa verticillaris*, Ehb., and *Primnoa gracilis*, Milne-Edw., were placed as synonyms. The genus *Calligorgia* falls under the family of the Calligorgiadae, which contains very heterogeneous materials. In the diagnosis of the genus we again have the character that only three cells form a whorl, while in the diagnosis of the only species varieties are mentioned at one time with ten to twenty cells, at another time with four cells in a whorl. Studer in the Alcyonaria of the voyage of the "Gazelle," 1878 (*loc. cit.*), adopts the genus but also unites thereunder the genera *Xiphocella*, Gray, *Callicella*, Gray, and *Fanellia*, Gray, the latter founded on Verrill's description of an axis and placed by Gray in his family of the Primnoidae.

Studer's diagnosis runs :—Stem ramified, mostly in one plane, the club-shaped calyces are generally scattered on the stem, but on the branches they are in whorls of eight to ten. The calyx scales are more or less fan-shaped, warty, with ribs arranged fan-like, which on the upper edge project as spines.

The genus *Caligorgia* is here retained in Studer's sense, and as Dr. Gray intended to use the Greek *καλη* (*pulchra*) and not *καλλος* (*pulcher*), the spelling has been altered.

In *Caligorgia* the stem is upright, ramified mostly in one plane, but it is never dichotomous. The axis is horny, calcareous, rigid, whitish, and ascends from a flat calcareous base which spreads over foreign bodies. The axis is for the most part compressed in the same plane as that in which the branches expand, sometimes completely flattened. The main stem gives off smaller and larger branches on either side, the latter frequently of the stoutness of the main stem, these either remain simple or may again give off twigs. The branches and twigs always come off alternately on both sides of the stem, and mostly stand at sharp angles to their support.

Stem and branches are covered with polyp calyces, which are irregularly placed on the thicker parts of the stem and on the branches; on the thinner branches and twigs they are arranged in whorls, which appear to be always composed of more than three cells. The calyces are cylindrical to club-shaped, with a thickened mouth portion, and in repose and death are bent inwards towards the stem.

The coenenchyma contains two layers of spicules, an outer layer of larger, warty, mostly small, almost spindle-shaped and often bent spicules, which lie close together, and a lower layer of smaller, but similarly formed, calcareous bodies. The calyces are distinctly bilateral, their backs and sides are covered with tile-like, overlapping scales, which mostly form four longitudinal rows, the ventral part is naked, only the edge of the calyx



opening exhibits ventrally a scale, or several little scales, which afford the support for the ventral opercular scales. The operculum consists of eight triangular pointed scales with broad, spiny bases; it is distinctly bilateral. The two dorsal pieces of the operculum are the largest and cover with their edges the next smaller dorso-lateral scales, these again the ventro-lateral ones. The small ventral pieces are most deeply placed. The calyx scales are very characteristic. From the nucleus, which is always somewhat concentrically placed, rough prominences radiate to the edges. These are frequently produced into short spines, and are sometimes united into thorny ribs which run out into spines on the upper edge of the scale. *Caligorgia flabellum* (Ehbg.), and *Caligorgia compressa*, Verr., show the highest degree of development, while more delicate forms still remind one of *Plumarella* in the structure of the scales.

The growth of the colony is intercalary. New calyces arise on the inside of the base of the old ones, so that first at the base of one whorl a new whorl begins to be formed, which through further growth of the internode gradually moves away from the first.

The enumeration of the species here depends upon the development of the calyx scales; the first to be mentioned still exhibit an approach to the genus *Plumarella*.

1. *Caligorgia sertosa*, n. sp. (Pl. XIV. fig. 2a; Pl. XXI. fig. 9).

The slender upright stem gives off branches on two sides in alternating series; these remain simple and bear whorls of always four calyces. Each whorl is separated from the next by a wide interspace. The small calyces, 1.5 mm. long, bear four longitudinal rows of broad scales, of which only two are visible from the dorsal side. There is only one ventral scale on the edge of the calyx, the remainder of the ventral area is naked. The operculum is bilateral, its ventral scales very small, half covered by the lateral ones. When they are laid together the operculum forms a sharp cone over the obliquely truncated mouth-opening.

The little colony, unfortunately broken into several pieces, resembles in habit *Sertularia abietina*. The stem, of which the base is wanting, ascends straight up to a height of 210 mm. Its diameter reaches 2 mm. at the beginning; at 20 mm. from the apex it is still 1 mm. Its transverse section is at the commencement cylindrical, but becomes oval from the place where the branches come off. These first begin at a height of 70 mm. They are simple, unbranched, and arise in alternating series at distances of 10 to 11 mm. on one side. They come off from the stem at angles of nearly 45°, their greatest length reaches in the middle of the colony 45 mm.; towards the apex and the base they gradually decrease in length. Polyp calyces are placed solitary on the last third of the stem, but they form on all the twigs successive whorls of four polyps. The whorls are separated from one another by an interspace of 1 mm. The calyces are small, cylindrical, somewhat thickened towards the mouth-opening; their length reaches 1.5 mm.

The axis is hard, calcareous, brittle, of a whitish-yellow colour, but towards the end of the twigs it becomes more flexible.

The spicules of the calyx are arranged in four longitudinal rows of seven or eight scales, of which the two dorsal rows contain the largest scales, and on the dorsal aspect are alone visible; the ventral side of the calyx is scaleless, only on its upper edge is one scale developed as a support for the ventral opercular scales.

The spicules are broader than high, relatively thin; the prominences radiating from the nucleus to the dorsal edge are not much developed, and become pointed only in the dorsal rows so as to form a row of teeth on the edge. Ribs are weakly developed and only in the uppermost row. Length to breadth in mm.—0·2–0·35; 0·18–0·35; 0·15–0·25; 0·13–0·27; 0·13–0·23. The ventral scale is triangular, covered with small prominences, 0·16 to 0·14 mm.

The bilaterally arranged opercular scales exhibit a median keel, which ends in a little spine. The dorsal measure 0·3–0·167; lateral 0·3–0·17; ventral 0·23–0·15 mm.

The scales of the cœnenchyma are tuberculated, thick, bent or oval plates, whose edges are toothed, they lie close together, with the edges touching. Those of the upper layer exhibit the following sizes in mm. Length to breadth—0·32–0·14; 0·4–0·27; 0·3–0·17; 0·35–0·12; 0·2–0·06. Lower layer, 0·1–0·05.

*Habitat*.—Station 192, off the Ki Islands, south of Papua; depth, 140 fathoms; bottom, blue mud. Only one specimen of this very elegant form was dredged.

[2. *Caligorgia ventilabrum*, Studer.

*Caligorgia ventilabrum*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 647, Taf. ii. fig. 12, *a*, *b*, *c*, *d*.

North of New Zealand; depth, 90 fathoms.

3. *Caligorgia gracilis* (Milne-Edwards).

*Primnoa gracilis*, M.-Edw., Hist. Nat. des Coralliaires, t. i. p. 141.

West Indies.

4. *Caligorgia verticillata* (Pallas).

*Gorgonia verticillata*, Pall., Elench. Zooph., p. 177.

„ *verticillaris*, Solander and Ellis, Zooph., p. 83.

*Muricea verticillaris*, Dana, Amer. Explor. Exped. Zooph., p. 675.

*Primnoa verticillaris*, M.-Edw., Hist. Nat. des Coralliaires, t. i. p. 140.

„ „ Kent, Monthly Micr. Journ., February 1870, pl. xli. figs. 8, 9 (figures of spicules).

„ „ Kölliker, Icon. Histiol., Taf. xvii. fig. 12 (spicules).

„ „ v. Koch, Mitth. Zool. Stat. Neapel, Bd. iii. p. 546.

„ „ v. Koch, Morph. Jahrb., Bd. iv. p. 457, 1878.

Mediterranean, Azores.]

5. *Caligorgia flabellum* (Ehrenberg) (Pl. XIV. fig. 2).

*Prymnoa flabellum*, Ehb., Corall. d. roth. Meeres, p. 134.

*Gorgonia verticillaris*, Esper, Fortsetz. d. Pflanzenthier, i. p. 156, pl. xlii.

*Xiphocella esperi*, Gray, Cat. Lithophytes Brit. Mus., p. 36.

*Caligorgia verticillata*, var., Gray, loc. cit., p. 35.

*Calicella elegans*, Gray, loc. cit., p. 37.

*Caligorgia flabellum*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 646, Taf. ii. fig. 13, a, b.

The species was founded by Ehrenberg for a Primnoid which the Berlin Museum had received with the Gerresheim collection. The species is not difficult to distinguish from others, especially from *Caligorgia verticillata* (Pall.). The axis of the main stem and of the main branches are compressed; this circumstance gave Gray occasion for the formation of his genus *Xiphocella*. The twigs come off at sharp angles on both sides of the stem and branches in alternating series. The number of cells forming a whorl varies; on the thicker branches there are eight, on the thinner six calyces, on the thin terminal twigs only four. Gray figures such terminal twigs under the name of *Calicella elegans*. The generic character which should separate *Calicella* from *Caligorgia*, namely the dichotomous ramification of the branches, exists here to as slight an extent as in any Gorgonid. The length of the polyps reaches up to 1 mm. They have four longitudinal rows of spicules, which cover the dorsal and lateral sides of the calyx; the ventral side is naked, only at the edge of the oral disc there are several small scales developed.

The operculum consists of eight scales, of which the ventral ones are the innermost and smallest. The form of the spicules is very characteristic. The calyx scales are broader than high, the prominences are elongated into sharp spines, which project from the surface of the calyx and form sharp projections on the edge. Length to breadth in mm. —0·23–0·35; 0·28–0·47; 0·26–0·33; 0·3–0·4. The opercular scales are large, the prominences up to the edge are produced into spines, and the lateral edges are toothed. A median keel is present in the dorsal opercular scales, which reach up to 0·7 mm. in length; the lateral ones attain a length of 0·5 mm. with a base of 0·25 mm.; the ventral ones 0·4 to 0·12. With these forms of spicules those of the type specimen of Gray's *Calicella elegans* agree.

The Challenger collection contains only a few branches, which in accordance with the structure of the calyx scales must be referred to this species. Their twigs are very robust and the calyces large and well developed; six to eight calyces form a whorl. The species has been obtained from Japan, Formosa, and the western part of the Indian Ocean. The Japanese specimens have the spines on the scales more strongly developed than those from the Indian Ocean or than those from the original specimen described by Ehrenberg.

*Habitat*.—Station 232, *Hyalonema*-ground, south of Japan; depth, 345 fathoms; bottom, green mud.

[Formosa (Gray); Japan (Dr. Hilgendorf, Dr. Döderlein); Mauritius (Bern Museum).]

[6. *Caligorgia compressa* (Verrill).

*Primnoa verticillaris*, Ehrbg., Corall. d. roth. Meeres, p. 133.

*Primnoa compressa*, Verrill, Proc. Essex. Inst., 1865, p. 189.

*Fanellia compressa*, Gray, Cat. Lithophytes Brit. Mus., 1870, p. 46.

*Caligorgia verticillata*, Gray, *op. cit.*, p. 35.

*Monilia annulata*, Valenc., Paris Museum, Jardin des Plantes.

*Caligorgia compressa*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 647.

*Habitat*.—Aleutian Islands (Verrill); North Pacific Ocean (Adalbert von Chamisso, Berlin Museum).

This species is distinguished, independently of the very strongly compressed axis, by the great number of polyps, ten to twelve of which form a whorl, and the form of the calyx scales. These latter are very broad, measuring 0.41 by 0.2; 0.4 by 0.3 mm., and are covered with prominences, which, however, form sharp spines rather than coarse, thorny protuberances. The upper edge of the scale is more obtusely but more richly toothed than in *Caligorgia flabellum*. The opercular scales likewise exhibit thorny protuberances up to the very edges. The spicules of *Monilia annulata*, Val., in the collection of the Museum of Paris, agree completely with those of the typical specimens.]

Genus 8. *Primnoella*, Gray.

*Primnoella*, Gray, Proc. Zool. Soc. Lond., 1857, p. 286.

The genus *Primnoella* was instituted in the year 1857 by Gray for a Primnoid which he had described in the year 1849 under the name of *Primnoa australasiæ*. Gray's diagnosis runs:—"Coral simple, elongate, cylindrical. Axis continued, stony. Bark granular, smooth. Polypiferous cells numerous, close pressed, subcylindrical, regular, small, placed in close regular circles, each containing many cells round the stem; each cell covered with two series of small imbricate scales."

The type species is *Primnoa australasiæ*, Gray.<sup>1</sup> Gray also refers *Primnoa vetusta*, Kölliker, to this species.<sup>2</sup> Kölliker figures sections of the axes of a Gorgonellacean, which, in the description of pl. xiv., is described as *Juncella vetusta* under fig. 12, and as *Primnoa vetusta* under fig. 19. The specimen came from Michelotti and was described by him as *Leiopathes vetusta* in manuscript. Since Kölliker in the text of his book only

<sup>1</sup> Cat. Lithophytes Brit. Mus., 1870, p. 50.

<sup>2</sup> Icon. Histiol., pl. xiv. figs. 9, 12.

refers to fig. 14 as *Juncella vetusta*, doubtless he regarded the axis as belonging to a Gorgonellid, and hence Gray's inclusion of the same under *Primnoella* is apparently not justified.

In 1878 Studer placed three new species in the genus, all collected by the "Gazelle" from deep water in the southern hemisphere (*op. cit.*). At the same time the generic diagnosis was somewhat modified by him. He characterises the genus thus:—"Coral simple, unbranched. Axis horny, calcareous. Bark thin. The polyp cells around the stem in regular whorls of more than three cells. Cells covered with small overlapping scales, which are mostly unsymmetrical and toothed on the edges."

Three more species were collected by the Challenger, so that thereby the number of known species amounts to seven.

The colony consists of a simple, at times much elongated stem, which ascends from a root-like portion, which affixes itself to foreign bodies. On the stem are placed the calyces in whorls of from four to twenty, the distances between two whorls (the internodes) may be longer or shorter than the calyces. The root is always calcified, it either forms a disc-like calcareous lamella, or it consists (*Primnoella distans*) of branched, stolon-like processes, which are either embedded in the mud or hold on to foreign bodies. The axis is on an average thin, often quite thread-like, it is in individual species completely horny, flexible and elastic, in others calcareous and brittle towards the base, but further up the stem it is flexible.

The coenenchyma is very thin on the internodes and contains only a single layer of flat, scale-like, calcareous spicules. The calyces are distinctly bilateral, their transverse section oval, the shorter axis is placed perpendicularly to the long axis of the stem. One can accordingly distinguish a dorsal portion, turned away from the stem, a ventral portion, turned towards the stem, and two lateral portions. The calyx scales form perpendicular rows, the elements of which, however, are not parallel to one another, but are inclined towards one another, mostly about half the height of a scale, and the upper edges of which project above the base of the succeeding one; in like manner the scales of one row usually overlap those of the next with their lateral edges. The scales of the ventral side are smaller and flatter than those of the dorsal side, which are often sculptured or provided with spines.

Around the mouth of the calyx the scales form an operculum-like crown of eight scales, which are mostly elongated and three-cornered and appear more or less strongly developed. These opercular scales always arise inside the last circle of the calyx scales and exhibit a distinctly bilateral arrangement. Two dorsal scales and two ventral ones are always placed opposite to one another, and there are always two lateral ones. These opercular pieces are always arranged so that the dorsal scales may overlap the next ventral ones with their edges, and so that the two ventral opercular scales come to be deepest, and close the calyx like a lower lip. The spicules of the operculum are either

long and narrow and form, when closed, a cone over the mouth of the polyp, or they are short and flap-like so that the closed mouth of the polyp appears evenly truncated.

The calyx scales have generally the form of an irregular quadrangle. The nucleus, consisting of small calcareous granules, is always excentric, whereby the quadrangle in all cases appears inequilateral. From the nucleus little protuberances radiate outwards towards the edges. The free edge of the scale is smooth, the covered edge is provided with small teeth and projecting spines. The scales of the cœnenchyma, which are so placed as to cover each other with their edges, are very irregular, oval, or angular little discs, always much smaller than the scales of the calyx. One can distinguish an outer layer of flat, warty, little discs, and a inner layer of spiny spicules which are more spindle-shaped, sometimes branched, and recall the spicules of the Muriceidæ.

The bilateral symmetry is evident in the internal organization of the polyp as well as in the form of the calyx. The œsophageal tube is laterally compressed, the two ventral and the dorsal mesenterial folds are shorter than the lateral ones and inclose a ventral and a dorsal chamber, which are distinctly smaller than the six lateral ones. During life the polyps may be stretched out straight from the stem and may again be bent in towards the stem, in this position they are found in all dead and dried specimens or in those preserved in spirits. The canal system of the colony consists of eight longitudinal canals, which are arranged strictly radially around the axis of the stem and are separated from one another only by thin septa. Into these canals, which traverse the entire stem, a net-like anastomosing system of narrow canals opens, which originates from the digestive cavities of the polyps. A canal always arises from each mesenterial chamber of each polyp, and unites in a net-like manner with its fellows in the cœnenchyma. Ova and spermatozoa arise on the mesenterial folds below the œsophageal tube; hermaphroditism appears not to take place; on the contrary, in *Primnoa flagellum* at least, the colonies are dioecious. New polyps arise by budding from the canal system in the internodes between two whorls of polyps, at first they are situated ventrally to the base of a whorl of polyps and as they grow larger they gradually become further removed from it by simultaneous growth of the internodes. The growth of the colony accordingly takes place in the internodes of the whole stem at the same time. A resolution of the polyps appears to set in gradually at the base of the stem. The lowest circles have generally a smaller number of polyps than those higher up. The most vigorous development always takes place in the middle of the stem. The number and arrangement of the calyx scales is precisely the same in the youngest buds as in the most developed, so that the scales increase in size with the growth of the calyx.

The species of this genus are inhabitants of deep water, and as yet have only been found in seas south of the equator, in water of low temperature, and at depths of 40 to 600 fathoms.

The genus may be divided into two groups, which, however, are not sharply divided from one another. In the first the dorsal calyx scales are numerous, in several rows; in the second there are only two dorsal longitudinal rows, which come together at an angle so that the calyx appears provided with a dorsal keel; we may distinguish them as *Convexæ* and *Carinataæ*.

A. *Convexæ*.

1. *Primnoella magellanica*, Studer (Pl. XVII. fig. 2; Pl. XXI. fig. 10).

*Primnoella magellanica*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 644.

A fragment in the collection, representing the root portion of a colony with a stem 40 mm. long, may be referred to this species. The fragment in question exhibits, indeed, some deviations from that which afforded the basis for the first description, which are, however, elucidated by the fact that we are here dealing with the lower end of an evidently very old colony. The root portion in the present instance forms a short cone of calcareous matter, the flattened base of which has a diameter of 11 mm.; from its apex arises the (in this case) calcareous, brittle stem, which has a diameter of 2 mm., but which rapidly diminishes above and becomes more flexible. The calyces commence at a height of 5 mm., the first whorl consists of two not quite opposite polyps, the next of six, the third of eight. The calyces have a height of 2 mm. by a diameter of 1 mm. In individual places the whorls are not quite regularly placed, especially where, towards the end, new rows of polyps develop between the old ones. In the figure the internodes are made too long. The calyces of one whorl, when laid against the stem, always cover the base of the next whorl.

The scales of the calyces are very numerous and relatively small. In the length of the calyx ten to thirteen calyx scales may be counted. The scales are broad, flat, covered with small prominences, and overlap each other with their edges like roof-tiles. Towards the base of the calyx they become smaller and on the stem pass over into small, flat, oval plates. The operculum of the calyx is formed of eight pointed, triangular scales, the base of the triangle is covered with little prominences, the apex smooth, with a keel, which is produced into a short spine. The spicules of the operculum exhibit the usual arrangement, and when laid together, form a pointed cone over the mouth of the calyx.

Calyx scales as broad, or a little broader than high, unequilaterally quadrangular, the lower edge convex, more convex in the upper scales than in those nearer the base, irregularly toothed, the upper edge nearly smooth. Breadth 0.3 mm., height 0.31 mm., breadth 0.37 mm., length 0.36 mm., breadth 0.16 mm., height 0.16 mm. The latter from the base.

Opercular scales; dorsal scales 0.48 mm. high, 0.2 mm. broad; ventral 0.29 mm. high, 0.12 mm. broad at the base.

Scales of the cœnenchyma irregularly polygonal or oval; height to breadth—0.12–0.1; 0.12–0.06; 0.12–0.1; 0.22–0.15; 0.16–0.14; 0.16–0.16 mm.

*Habitat*.—Station 320, off Monte Video; depth, 600 fathoms; bottom, green sand. [Magellan Straits, 42 fathoms; rock ("Gazelle").]

2. *Primnoella murrayi*, n. sp. (Pl. XVIII. figs. 3, 3a; Pl. XXI. fig. 11).

In habit resembling the foregoing, but may be distinguished at the first glance by the fact that each dorsal calyx scale bears a blunt spine. The slender little stem rises from a flat, expanded root, which has grown amidst a colony of Polyzoa, its apex is broken off at a height of 50 mm. The axis is relatively stout at the base, 0.5 mm., but soon diminishes to the thinness of a thread, yet it remains brittle and is but little flexible throughout its entire course. It exhibits eight longitudinal furrows, corresponding to the boundaries of the eight longitudinal canals, its colour is horny yellow. On the stem the polyps form close whorls of six to eight, the first whorl with eight polyps commences at 9.5 mm. above the root. The calyces, 3 mm. long and 1 mm. in diameter, appear somewhat thickened towards the oral region and are uniformly bent towards the stem. The internodes between the whorls are in this case visible, in that the apices of the cells do not reach the base of the next whorl. The calyces are covered with large scales, which lie over one another in eight to nine rows. Three longitudinal rows of dorsal scales are visible. The broad dorsal scales, covered with little prominences, after the first third of the calyx, become strongly convex and develop a median keel which is produced into a grooved spine, and when the calyx is bent stands out towards the circumference. Towards the mouth of the calyx the spines increase slightly in size. The ventral scales are small, smooth and flat, separated in the ventral line by a membranous interspace. The opercular scales are short and broad, lancet-shaped, and cover the mouth like a flap. The mouth appears truncated. The ventral opercular scales are not covered by the lateral ones.

Calyx scales strongly convex, the lateral edges drawn out, in the three or four upper rows the upper edge runs out into a blunt point, sometimes slightly serrate at the end; the lower edge is strongly convex, with unsymmetrically distributed teeth. Uppermost row, length to breadth, 0.6–0.54 mm.; second row 0.4–0.55 mm. Lower row without spines, 0.4–0.54 mm. Opercular scales; dorsal scales, broad, triangular 0.45–0.53 mm.; lateral scales 0.54–0.17 mm.; ventral scales 0.25–0.09 mm. Spicules of the cœnenchyma, unequal four-sided or three-sided plates, 0.4–0.3 and 0.4–0.2 mm.

*Habitat*.—Station 320, off Monte Video; depth, 600 fathoms; bottom, green mud.



*Primnoella flagellum*, Studer (Pl. XVIII. figs. 2, 2a; Pl. XXI. fig. 12).

*Primnoella flagellum*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 645, 1878.

Several colonies in the collection, which are unfortunately unattached, belong to this species.

The uniform thinness and flexibility of the entirely horny axis, which may be bent in every direction, at once separates this species from *Primnoella magellanica*.

The almost cylindrical polyps form whorls of from six to eight, which are placed so far from one another that the internodes are not quite covered. The calyx scales are larger than in *Primnoella magellanica*; three dorsal longitudinal rows are visible, which are arranged in eight to nine in the "Gazelle" specimens, in eight to eleven in the Challenger ones. The ventral scales are well developed and form two rows. The length of the cells reaches 2 to 2.5 mm., their diameter 1 mm. The opercular scales are triangular, and are produced at the end into a flat knob, which projects distinctly from the edge of the scale.

Spicules.—Calyx scales; the upper edge strongly convex in those nearer the mouth, those at the base with straighter upper and lower edge. The latter always strongly toothed. Length to breadth, 0.45–0.4; 0.29–0.34; 0.35–0.45 mm.; the latter near the base of the calyx. Opercular scales three-sided, smooth, with a blunt point; dorsal 0.63–0.29 mm.; ventral 0.37–0.15 mm. Spicules of the cœnenchyma, longish oval, 0.23–0.13; 0.22–0.19 mm.

*Habitat*.—Station 308, off Tom Bay, Patagonia; depth, 175 fathoms; bottom, blue mud.

[Lat. 43° 56' 2" S., long. 60° 25' 2" W.; depth, 60 fathoms; bottom, sandy mud ("Gazelle").]

*Primnoella distans*, Studer (Pl. XVII. figs. 1, 1a).

*Primnoella distans*, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 644, Tab. i. fig. 9, 1878.

This delicate form is represented in the Challenger collection by several specimens, and colonies are present which still retain the root-end, which was wanting in the original specimen. The root here consists of branched stolon-like calcareous lamellæ, whose edges are inflected and provided with little processes. In one case the root consists of two calcareous lamellæ, which are twisted spirally around the axis, then they fuse, again dividing into two divergent roots, each of which again divides into two terminal branches. Each forms a calcareous lamella, which is folded together so as to form a groove, from the edges of which small branched rootlets again come off. The entire structure forcibly calls to mind the stolon-like roots of *Strophogorgia* and *Ceratoisis*. The stem of the coral arises immediately from the root-lamella. The axis forms a flexible horny stem, having a diameter of 0.5 mm. at the base and is covered only by a

very thin cœenchyma. The polyps form whorls on the stem at intervals of 3 to 4 mm. The first whorls, which arise high up on the stem, contain only two opposite polyps, the next three, then four, sometimes five. The calyces themselves are high, cup-shaped, 1.5 to 2 mm. long. The calyx scales are large, from the dorsal side only two longitudinal rows are visible, which form seven to eight transverse rows. The ventral scales consist only of one row of very thin, transparent little plates, whose edges are covered by the side edges of the lateral scales. The opercular scales are large, arched, pointed, the two ventral ones are the smallest. When laid together they form a sharp cone.

Calyx scales four-cornered, broader than high, those of the uppermost row with strongly convex upper and lower edges, which are strongly toothed. Height to breadth, 0.3–0.3; 0.2–0.33; 0.2–0.3; 0.2–0.25 mm. Opercular scales; dorsal 0.27–0.13 mm.; lateral 0.2–0.08 mm.; ventral 0.12–0.05 mm. Cœenchyma spicules, irregularly polygonal or oval little plates, 0.15–0.2; 0.2–0.12 mm.

*Habitat*.—Station 23, off Sombrero, West Indies; depth, 450 fathoms; bottom, Pteropod ooze. One specimen.

Station 122A–C, off Pernambuco; depth, 120 to 400 fathoms; bottom, red mud. Four specimens.

[Lat. 22° 21' S., long. 154° 17' 5" E.; depth, 550 fathoms; bottom, Globigerina ooze ("Gazelle").]

*Primnoella grandisquamis*, n. sp. (Pl. XVII. fig. 4; Pl. XXI. fig. 13).

A long stem, flexible in all directions, the root of which is wanting, bears whorls of four to six polyps, which surround the stem at tolerable intervals from one another. The calyces are covered with two dorsal rows of large scales. The spicules of the operculum are, in contrast to those of the foregoing species, small, and not prominent in the bent-in calyces. The stem has a length of 39 mm., but the upper and lower ends are wanting. The axis is of thread-like thinness, only 0.5 mm. in diameter when covered with the cœenchyma, it is entirely horny and movable in every direction, in fluid it has a tendency to roll together spirally. The polyps form whorls of four, five, or six around the stem; the whorls are tolerably far apart from one another, so that from the calycine apices of one whorl to the bases of the next there is an interval of 1.5 to 2 mm. The calyces themselves have a tolerably uniform thickness throughout their length, only somewhat thicker towards the mouth. Their length reaches 1.5 mm., their diameter up to 0.7 mm. Whorls of new young polyp buds are often visible in the internodes. The scales of the calyx are very large, transversely elongated. Dorsally only two longitudinal rows are recognisable, of which the lateral edges of one row always overlap those of the other. There are seven transverse rows

of scales on the calyx. The ventral scales are quite rudimentary. The opercular scales are flat structures, of which the smaller ventral ones are almost completely covered by the side edges of the next lateral ones. When closed together they form a flat, not prominent operculum.

Calyx scales always broader than high, the lateral edges very unequal. The one free edge mostly contracted, that which is covered by the free edge of the others convex, broad and strongly toothed, as likewise the lower edge. The upper edge is not convex. The scales decrease in height from above downwards. Height to breadth, 0.25–0.33; 0.25–0.32; 0.17–0.38 mm. Ventral calyx spicules are spiny scales, 0.16–0.17 mm. Opercular scales, short and flat, 0.2–0.1 mm. Cœnenchyma spicules, oval, four-cornered to polygonal plates; at the base of the calyx 0.36 mm. long., 0.22 mm. broad; on the stem smaller, with the lateral edges overlapping, the covered edge always toothed, 0.12–0.23; 0.15–0.12; 0.19–0.12; 0.16–0.08 mm.

This species, in the condition of the dorsal calyx scales, unites the *Convexæ* with the *Carinatæ*, in which the two rows of calyx scales come together at an angle.

*Habitat*.—Station 163A, off Twofold Bay, Australia; depth, 150 fathoms; bottom, green mud.

#### B. *Carinatæ*.

##### *Primnoella biserialis*, n. sp. (Pl. XVII. fig. 3; Pl. XXI. fig. 14).

A stem, 25 mm. long, without root and apex, bears whorls of eight polyps at wide intervals. These are covered dorsally with two longitudinal rows of scales, which come together at an angle, and form thereby a dorsal keel. The axis is thin, in the basal part yellowish-brown, and somewhat brittle from a deposit of calcareous salts, in its further course it is horny and flexible, but not in such a degree as in the two foregoing species. Thickness at the base 1 mm. The calyces commence at a height of 30 mm. up the stem, at first with whorls of four, then of six, and further on of eight polyps. The calycine apices of one whorl do not reach the bases of that of the next, there always remains an interval, averaging 1 mm. The length of the calyx reaches 1.5 mm. When laid against the stem the calyces join laterally with one another very closely, so that each whorl when viewed superficially looks like a thickening of the stem, and thereby the whole acquires an appearance like a rosary. Each calyx is covered dorsally by two alternating rows of broad, flat scales, which come together at an angle in the mid dorsal line. Sixteen to eighteen scales lie over one another in a longitudinal row. These are sharply marked off from the scales of the cœnenchyma, which form polygonal plates. Ventrally the median line is membranous, with rudimentary calcareous bodies, bounded laterally by two lateral rows of small scales. The calyx mouth is large, oval.

The opercular scales are small discs, and are not capable of completely closing the opening of the calyx.

The calyx scales are rectangular, very broad and flat, with an upper smooth edge and a toothed lower edge; the edge of that scale which is laterally covered by the next is likewise toothed. Near the base the scales become somewhat higher, and their form irregular. Height to breadth, 0·12–0·26; 0·13–0·29; 0·15–0·3; 0·13–0·26 mm.

The opercular scales are short, relatively broad little plates, which appear truncated, with the exception of the dorsal ones, which are pointed at the end. Height to breadth, 0·06–0·07; 0·11–0·1; 0·12–0·1 mm. The scales of the *cœnenchyma* are irregularly triangular or polygonal, 0·26–0·14; 0·27–0·12; 0·17–0·13 mm.; in the lower layer they form warty spindles which are at times forked, 0·09 and 0·07 mm. long.

*Habitat*.—Station 308, off Tom Bay, Patagonia; lat. 50° 10' S., long. 74° 42' W.; depth, 175 fathoms; bottom, mud.

*Primnoella australasiæ*, Gray (Pl. XVIII. figs. 1, 1a; Pl. XXI. fig. 15).

*Primnoa australasiæ*, Gray, Proc. Zool. Soc. Lond., 1849, p. 146, pl. ii. figs. 8, 9.

*Primnoella australasiæ*, Gray, Ann. and Mag. Nat. Hist., ser. 2, vol. v. p. 510, 1850.

„ „ Gray, Proc. Zool. Soc. Lond., 1857, p. 286; 1859, p. 483.

„ „ Gray, Cat. Lithophytes Brit. Mus., 1870, p. 50.

„ „ Verrill, Bull. U.S. Nat. Mus., 1876, No. 3, p. 76.

Several specimens of *Primnoella* from the Challenger collection may be referred to this species. The numerous cells which constitute the whorls and are provided with two dorsal longitudinal rows of scales coming together at an angle, easily characterise the species. The figures of Gray show (*loc. cit.*, fig. 9) a whorl of polyps seen from the side, and (fig. 8) a piece of the stem with a row of six whorls. Although many details are left unrepresented in the figure, yet the species may be recognised thereby. The description of the species, as is usual with Gray, is very short, and only in his later publications was the generic diagnosis of *Primnoella* given. In 1876 Verrill (*loc. cit.*), with his usual ability, gave a detailed description.

Of the several specimens which must be distinctly referred to this species as found in the Challenger collection, the largest has a length of 500 mm.; the thickness of the axis at its base is 2 mm. Sixteen to twenty calyces are to be found, each 2 mm. long, on each closely packed whorl. Typical pieces come from Port Jackson, Australia, from a depth of 30 to 35 fathoms.

Near to this station, in Twofold Bay, specimens were dredged from a depth of 150 fathoms, which in the form of the calyces and scales appear to belong to the same species, but differ with regard to the number of calyces which constitute a whorl.

One specimen has a length of 116 cm. The lower part of the stem is devoid of coenenchyma and polyps, and is partly overgrown with colonies of Polyzoa and with Ascidians. The coenenchyma is first met with at a height of 36 mm. The axis has at the base a thickness of 2.5 mm., but soon diminishes to 1 mm. in diameter; it is hard and calcareous at the commencement, but soon becomes soft and horny, with a tendency to bend itself together spirally. There are only eight to twelve polyps in a whorl, whereby the colony appears much thinner and more thread-like than in the typical specimens from shallow water. From the same spot came also specimens which appear still slenderer, the polyps in which are placed around the stem in whorls of from eight to ten, and have a very small diameter; their more minute structure, however, agrees with that of the typical specimens.

The calyces of this species are covered with scales, which form two dorsal, two lateral, and four ventral longitudinal rows. The two dorsal rows of scales, visible only in the calyces bent in to the stem, come together at obtuse angles in the middle line. The scales of the two rows are placed alternately, so that one scale is always in contact with two half scales of the other row. The ventral spicules form only small, thin scales, arranged in four irregular rows. The outer rows are covered over by the edges of the lateral scales.

The opercular scales are very short, with evenly truncated upper edges, they do not form a cone when laid together but cover the calyx flat.

Sizes of the spicules.—Calyx scales, much broader than long, with straight upper edge and toothed lower edge; height to breadth, 0.2–0.33; 0.18–0.3; 0.16–0.2; 0.2–0.31; 0.2–0.3 mm.; lateral scales, 0.2–0.27; 0.26–0.23 mm.; ventral scales, 0.04–0.11; 0.1–0.11 mm. Opercular scales; dorsal 0.3–0.1 mm.; lateral 0.16–0.1; 0.2–0.158 mm.; ventral 0.18–0.06; 0.12–0.1 mm. Scales of the coenenchyma; outer layer, triangular to irregular longish polygonal, height to length, 0.31–0.2; 0.25–0.17; 0.27–0.2; 0.16–0.12; 0.2–0.018 mm.; inner layer, small, thin scales occur with only a few fine prominences, 0.1–0.15; 0.1–0.09 mm.

*Habitat*.—Port Jackson, Australia; depth, 30 to 35 fathoms.

Station 163A, off Twofold Bay, Australia; depth, 150 fathoms; bottom, green mud.

This species has already been very frequently collected as an inhabitant of shallow water. Gray gives the Australian Seas as a locality. Verrill obtained it from New Zealand, Bluff Harbour, one specimen from 7 fathoms, Tasmania. The museum of the Jardin des Plantes at Paris possesses a specimen from the Australian Sea which is 150 cm. long. The Godeffroy museum possessed specimens from Bass Strait.

## Subfamily 3. PRIMNOIDINÆ, n. subfam.

Colony branched, with oppositely placed polyps. The spicules are flat, thin scales, deposited uniformly in the cœnenchyma and in the polyp calyces, and covering each other like tiles on a roof. The opercular scales are not distinctly differentiated and therefore the oral region is only incompletely protected. The axis is horny, calcareous.

Genus *Primnoides*, n. gen.

An upright colony ramified in one plane, the branches arise oppositely and bear two rows of oppositely placed polyps. The spicules on the stem and calyces are flat, thin scales, which cover each other like roof tiles and are uniformly spread over the stem and calyces. The operculum is rudimentary and not capable of covering the mouth of the retracted polyp. Axis horny, calcareous. The polyps arise in an intercalary manner.

This peculiar form constitutes a type which differs from all other Primnoids in that a differentiation of the calcareous bodies into scales of the cœnenchyma, of the calyx, and of its operculum has not as yet taken place, or no longer occurs. The uniformly developed scales are, however, formed as in other Primnoids and are closely related to those of *Plumarella*. They are flat, thin, with a central nucleus surrounded by little prominences. The free projecting edge is convex, smooth and entire, the covered edge straight, thickened, and provided with teeth and spines. On the stem and branches the direction of the scales is usually towards the apex, where two calyces arise their direction deviates from the middle line towards the mouths of the calyces. At the oral region are found six to eight slightly projecting scales, which, however, do not form a proper operculum, and are not capable of closing the mouth in the contracted calyces. The axis is hard, horny, calcareous, only in the thinner twigs flexible and soft. Growth takes place as in *Primnoella*, *Caligorgia*, and others. New polyps arise in the interstices between the old ones, but always at some distance from the bases of the two polyps.

*Primnoides sertularoides*, n. sp. (Pl. XIX. fig. 1, 1a; Pl. XXI. fig. 16).

The upright, straight stem gives off opposite branches on two sides; the branches in most cases remain simple, and only exceptionally give off secondary branches in the same manner. The polyps arise oppositely from the stem and twigs at intervals of 2 mm. The calyces are wart-like, 1 to 1.5 mm. long, laterally compressed. They arise from the stem with a broad base and diminish towards the apex. The scales

which cover the calyx and stem are thin, entirely or half cycloid, with small prominences which surround the nucleus; between 0.27 and 0.12 mm. in diameter. In the cœnenchyma beneath the scales there is a layer of rough thorny spicules.

The entire colony forms a very elegant structure, which most closely resembles that of a Sertularian. The main stem is thin, near the base it is cylindrical, with a diameter of 1.5 mm. Its length reaches, in three specimens, 145 to 180 mm.; but the actual base is wanting in all the specimens. At a height of from 45 to 60 mm. the stem becomes flat and then gives off opposite branches on either side. The interval between two pairs of twigs, or the length of the internode, reaches in one specimen 15 mm., in another it varies between 15 and 25 mm. The terminal portion of the stem, which bears no branches, is 25 mm. long. The number of pairs of branches reaches in one colony five, in a second eight. The branches are largest at the commencement of the colony, generally the first to the third attains the maximum length, 80 to 85 mm., from the third they gradually decrease in length. The branches are simple, only in one specimen does a branch exhibit secondary twigs. The axis of the main stem is yellow, at the beginning hard and brittle, towards the apex flexible. The same condition prevails in the case of the twigs, only the smallest near the summit are quite flexible. On the stem and branches the cœnenchyma is thin and white, with two layers of spicules. The polyps commence low down on the stem, below the points of origin of the twigs, always opposite and in pairs, yet not all in the same plane; frequently two pairs are turned towards one another at angles of about 45° to 90°. They first arrange themselves in one plane between the twigs. The terminal portion of the stem exhibits a regular row of opposite polyps, between the two last a small portion of the stem projects, covered with cœnenchyma and forming the delicate apex. On the branches the pairs of polyps succeed at regular intervals of 2 mm. Here also now and again a pair come off in another plane. The polyps on the lower part of the stem are larger than the polyps on the twigs, cylindrical, 1.5 mm. long; those of the branches are more wart-like, with a broad base of attachment, 1 to 1.3 mm. long; young polyp buds arise between the old polyps, on the internodes.

The spicules, which cover the calyces and cœnenchyma like roof-tiles, are small and closely packed, on one calyx one may count over thirty longitudinal rows. They exhibit in their attitude to one another a quincuncial arrangement, like some reptilian scales. Their size does not vary much, only at the mouth of the calyx can one distinguish six to eight larger and more elongated scales, which project somewhat over the contracted mouth and constitute a rudimentary operculum, which does not, however, cover the mouth. The scales are thin discs, with a convex, semicircular free edge, and a straight, toothed lower edge, which is covered by the next scale. The nucleus stands out slightly and is surrounded by a few circular, small, smooth wartlets. Size

of the spicules; length to breadth in mm.:—Rudimentary opercular scales; 0·27–0·2. Calyx and outer layer of cœnenchyma scales, 0·2–0·2; 0·12–0·15, 0·13–0·12; 0·12–0·18; 0·14–0·15 mm. The deep spicules of the cœnenchyma are jagged, often branched spicules of irregular form, or small, triangular, thick discs with prominences, 0·17–0·12; 0·09–0·1; 0·08–0·05 mm. The small scales which cover the calyces are not capable of giving to the latter the rigidity found in other Primnoids, hence the calyces possess a soft, yielding structure.

*Habitat*.—Station 145A, off Prince Edward Island; depth, 310 fathoms; bottom, volcanic sand.

#### Family IV. MURICEIDÆ, Verrill.

##### *Muriceadæ*, Studer.

In this family we include those *Holaxonia* with a horny axis in which the cœnenchyma and the polyps contain large and variously formed calcareous spicules; the projecting points and spines of these latter giving to the colony a peculiar, irregular, roughened appearance. The polyps consist of basal portions armed with spicules, the calyx; of a naked portion which contains the œsophageal tube, the œsophageal portion; and the oral disc with the tentacles; the latter contain spicules in their basal portions which rest upon a collerette of spicules lying peripherally under the tentacular crown. In repose the tentacles are folded inwards so that the spicules of their bases lie together forming a covering over the mouth, while the whole œsophageal portion of the polyp is folded into the body-cavity. The spicules of the tentacles thus form a covering over the oral region. The chief characteristic of the family therefore lies in the peculiar habit of the polyps. In repose, the tentacles are always folded together over the oral disc (which becomes a little contracted) by which the basal portions of the tentacles, armed with spicules, form an operculum over it; the infolding of the œsophageal portion brings this operculum over the oral portion; sometimes, as in *Muricea* and *Elasmogorgia*, draws it into the body-cavity itself. This infolding takes place indeed in a very different degree, as will be seen, according to the genus. It occurs in a minimum degree in *Acanthogorgia*, where the polyp body is very much elongated and indeed only invaginates the oral disc; but here, as in some sort a protection of the soft parts of the body, the edges thereof are armed with sharp spicules. It occurs at a maximum in *Muricea* and *Elasmogorgia* where the tentacular covering is even withdrawn into the body-cavity.

The family of the Muriceidæ embraces the genera and species included by Studer in the Muriceadæ as a subfamily of Primnoidæ;<sup>1</sup> it is only lately that Verrill has rightly raised the subfamily to the rank of a family.<sup>2</sup>

<sup>1</sup> *Monatsber. d. k. preuss. Akad. d. Wiss. Berlin*, 1878, p. 641.

<sup>2</sup> *Bull. Mus. Comp. Zool.*, vol. xi. No. 1, 1883.



The presumed relationship of the Muriceidæ with the Primnoidæ rests moreover on a purely external resemblance. In both there are large surface spicules and opercular coverings, which latter can more or less close over the mouth. In the one group, however, the operculum is formed by the spicules at the base of the tentacles, in the other by those of the body edge. The formation of the polyps is also different in the two groups. The polyps in the Muriceidæ are retractile, but the amount of the retractability differs much. In *Acanthogorgia* the contraction of the polyps and the arrangement for the protection of the soft parts is still very imperfect (and somewhat as in the Ceratoisidæ); through *Muricea* they show affinities to the Plexauridæ; and through *Elasmogorgia* and *Muricella* with the Gorgonidæ.

The following fourteen genera occur in the Challenger collection. They may be arranged thus:—first, the forms with but slightly contracted tentacles; then those where the whole crown of tentacles can be concealed within the body.

<i>Acanthogorgia</i> , Gray.	<i>Placogorgia</i> , n. gen.
<i>Paramuricea</i> , Kölliker.	<i>Acamptogorgia</i> , n. gen.
<i>Anthomuricea</i> , n. gen.	<i>Echinogorgia</i> , Kölliker.
<i>Muriceides</i> , n. gen.	<i>Acis</i> , Duch. and Mich.
<i>Clematissa</i> , n. gen.	<i>Muricella</i> , Verrill.
<i>Villogorgia</i> , Duch. and Mich. ( <i>emend.</i> ).	<i>Elasmogorgia</i> , n. gen.
<i>Echinomuricea</i> , Verrill.	<i>Muricea</i> , Auct.

#### Genus 1. *Acanthogorgia*, Gray.

*Acanthogorgia*, Gray, Proc. Zool. Soc. Lond., 1857, p. 128.

„ Verrill, Bull. Mus. Comp. Zool., vol. xi. No. 1, fig. 30.

*Blepharogorgia*, Duch. et Mich., Supp. Mém. Corall. des Antilles, 1864-66, p. 109.

The genus *Acanthogorgia* is here taken in the emended sense of Verrill (*loc. cit.*). Verrill includes in the genus *Blepharogorgia*, Duch. and Mich., but excludes the species *Acanthogorgia grayi*, *Acanthogorgia atlantica*, John., and *Acanthogorgia hirta*, Pourt., which according to their spicules are to be placed in *Paramuricea*, Köll.; *Acanthogorgia johnsoni*, Studer, also belongs to *Paramuricea*. The following must be added to Verrill's characteristics with reference to the polyps and spicules. The polyps are elongated, cylindrical, expanded towards the mouth. The anterior part of the polyp is slightly retractile; in repose the tentacles bend together inwards over the mouth and are protected by spicules on their dorsal sides. The spicules are spindle-shaped and provided with spines, generally somewhat bent. They form eight longitudinal rows on the body of the polyp, the eight rows being arranged in pairs in a like manner, and the spicules of each paired row are at acute angles with each other. Towards the base of the tentacle the

angle always becomes more obtuse, and on the rim the bent spicules are placed nearly peripherally. Above these spicules there are straight, long, needle-shaped spicules, which are arranged not very regularly in eight rows placed longitudinally with regard to the polyp; near the edge these are very long and form far projecting bundles, which on the tentacles being folded stand up far above the polyp. Hence the polyps have a great resemblance to those of *Ceratoisis*, only in the latter the spicules which project above the polyps stand between the bases of the tentacles, while in *Acanthogorgia* they stand at the bases themselves. The axis is horny, fibrous, in the more slender branches it is often flattened and soft, so that the branches by the upright growth of the colony hang downwards.

The following species were collected during the voyage of the Challenger:—

1. *Acanthogorgia longiflora*, n. sp. (Pl. XXII. fig. 1; Pl. XXV. fig. 4).

The colony is sparsely branched in one plane. In the only specimen (in which the base is wanting) there arises a short stem, 1 mm. in diameter. At a height of 4 mm. this divides into two tendril-like, diverging branches. These branches are 0.4 mm. thick at the base and bend away from one another in an arching manner. They attain a length of 100 mm. Each gives off on one side simple rod-like twigs, 45 mm. in length, the first pair are at the base of the bifurcation, the next comes off in the middle of the main branches, the next three at long intervals and at nearly right angles. The branches and twigs are thin and soft and bend downwards towards the base.

The coenenchyma is very thin throughout and everywhere allows the yellowish-brown axis to show through. The polyps arise from the stem and branches at wide intervals from one another in alternating series. The intervals between them are irregular, often two on opposite sides follow close upon one another, while frequently they are 2 to 3 mm. apart. At the apex of the twigs they are more thickly placed, and often two to four are placed together round the stem. The apex of the twig is occupied by a polyp. The polyps are very much elongated, cylindrical, and expanded at the end, they are placed perpendicularly on their support but are frequently bent towards the apex of the branch, like the polyps of a Primnoid. Their length reaches 8 to 10 mm., their diameter 1 mm. Sometimes the lower half is thickened and swollen, so that the form becomes cup-like, whilst a constriction separates the basal part from the expanded tentacular part. When this is the case numerous ova are found present in the basal part. The tentacles appear but slightly retractile, only the apices are bent in, and the remaining portions, armed with spicules, are laid together over the mouth and form an operculum, which is scarcely overtopped by the eight groups of spicules developed on the margin of the polyp. The axis is altogether fibrous, horny, and in the branches and

twigs is quite soft, so that the latter are flexible in every direction and are like soft strings. The colour is brownish-yellow. The spicules in the cœnenchyma are long, slightly bent spindles and rods, which are armed with small, sharp, widely separated spines, they are closely placed in the longitudinal direction of the branches and twigs. Generally they are truncated at one end and pointed at the other and often somewhat bent in their course. Their length reaches 0.48; 0.25; 0.2 mm.; their thickness 0.015 mm. and less. In the polyps the spicules form eight longitudinal rows. Each longitudinal row is formed of two rows of spicules which converge towards the edge in a  $\Lambda$ -like manner and are covered again by straight longitudinally-placed spicules. These longitudinal rows are continued up into the bases of the tentacles, where they suddenly cease, so that they form eight radial lobes; from these arise the long bundles of spicules, composed of from two to three needles, which surround the oral region of the polyp. These latter contain needle-like spicules, 1.1 mm. long and 0.03 mm. thick, and 0.7 mm. long and 0.04 mm. thick. The spicules of the calyx wall have a lower, divergent, blunt end and run out into a point, they have small, sharp spines; length to breadth in mm.—0.6–0.025; 0.7–0.04; 0.4; 0.35–0.01. In the tentacles the spicules are placed longitudinally; they are thin, bent, and provided with small spines, 0.25 mm., towards the point only 0.1; 0.06 mm. long. The colour of the polyps and cœnenchyma in alcohol is yellowish.

*Habitat*.—Station 207, off Tablas, Philippine Islands; depth, 700 fathoms; bottom, blue mud.

2. *Acanthogorgia ridleyi*, n. sp. (Pl. XXII. fig. 3; Pl. XXV. fig. 2).

The colony consists of a simple stem which rises from a flat, horny base. The stem gives off thin, rod-like branches on three sides, of which those of two opposite sides are most developed and give off a few lateral twigs which remain simple. In the largest specimen the stem has a length of 250 mm. and at the base is 3 mm. thick. It begins to give off branches near the base, which are all unbranched, and of which those coming off in one plane, on two sides, attain a length of 95 mm., whilst the individual ones coming off in a third direction reach a length of 33 mm. Throughout the last 60 mm. of the stem no more branches are given off.

In a second specimen, in which the stem is 150 mm. long, branches come off in one plane at intervals of 5 to 10 mm., alternating on two sides of the stem, and having a length of 20 to 35 mm. The branches which arise in the third direction have at most a length of 5 mm. In a third specimen, 92 mm. long, the larger branches, which are 45 mm. long, develop simple lateral twigs.

The cœnenchyma is thin and transparent. The polyps are placed perpendicularly on the stem and branches at intervals of 3 to 4 mm. from one another. They form

short, irregular spirals, each of which consists of three polyps; young polyps and buds are developed everywhere between the old ones. The end of every twig and of the stem is always occupied by a polyp. The polyps are cylindrical, only expanded at the end, 3 mm. long. The spicules which surround the edge form bundles of at most three long needle-like forms. The tentacles are bent in from the base upwards.

The axis is horny, fibrous, soft and flexible, in the stem and branches it is somewhat flattened, in the thicker portions it is of a brownish hue.

The spicules in the cœnenchyma are longitudinally placed, and are generally curved, spiny spindles, whose ends sometimes give off lateral projections, 0.2 to 0.18 mm. to 0.4 mm. long; in the polyps the bent spiny spicules form eight longitudinal rows, which come together at angles and are relatively thick, 0.4 mm. long and 0.05 mm. in their greatest diameter.

The projecting spicules at the edge are slender, somewhat bent spindles, covered with a few sharp spines, 0.67 mm. and 0.54 mm. long, and 0.05 to 0.04 mm. in diameter.

The polyps are very like those of *Acanthogorgia* (*Blepharogorgia*) *schrammii*, Duch. and Mich., only in this species the polyps are smaller, 2 mm., and the spines on the edge of the calyx opposite to the calyx spicules are remarkably thick and coarse.

The colour in alcohol is brown.

*Habitat*.—Station 307, off Port Grappler, Patagonia; depth, 140 fathoms; bottom, blue mud.

### 3. *Acanthogorgia laxa*, n. sp. (Pl. XXII. fig. 2; Pl. XXV. fig. 3).

The upright stem gives off larger and smaller branches, chiefly on two sides, of which the former again branch many times. Between these arise other small, short branches from one side of the stem. The main stem is 7 mm. in diameter at the root and rises from a horny, flat base, it is flattened in one plane and is many times bent in its course. Its length reaches 160 mm. There arise, mainly from two sides, in irregularly alternating series, larger, ramified branches, and smaller, rod-like twigs. They arise at angles of 70° to 90° and are generally bent outwards in their further course, their soft, terminal portions, however, usually fall drooping towards the root. The larger branches attain a length of 150 mm. and have at their base a diameter of 3 mm., they again give off lateral twigs on two sides, which reach a length of 40 to 50 mm. The smaller, unramified branches are thin, generally bent outwardly in their course, and reach up to 52 mm. in length. Between the two rows of branches, which arise from the narrow edges of the stem, another row of small, thin twigs arises, which

bear only a few polyps. One side of the stem remains completely free. The polyps arise from the stem, branches and twigs; on the opposite sides only, irregularly alternating at distances of 2 to 2.5 mm.; only in isolated places there occurs between these a third row of polyps, but one face of the stem and twigs always remains free from polyps; towards the apex, where the polyps become very numerous and follow close upon one another, the entire periphery of the twig is occupied by them. The polyps stand up perpendicularly from their bases; they are cylindrical, slightly expanded at the end, 3 to 4.5 mm. long and 1 to 1.5 mm. in diameter; the bundles of spicules which surround their edges, to the number of eight, are relatively short. The cœnenchyma is very thin and transparent; the axis is horny, fibrous, soft and flexible, in the finer twigs flabby. In the stem and branches it appears flattened on one face. Its colour is a yellowish-brown.

The spicules are transparent spindles with only a few sharp spines. In the cœnenchyma they are placed in thick longitudinal series; those whose edges bear only a few blunt teeth measure 0.3 mm. and 0.05 mm.; isolated ones appear rounded at one end and slightly bent, 0.25 mm. long and 0.023 mm. thick, or these are slightly forked at one end, 0.25 mm. long and 0.07 mm. at the thicker end. At the bases of the polyps there are also peculiar spicules which are constricted in the middle and produced at both ends into two diverging arms, 0.3 mm. in length, and with a divergence of 1 mm. The spicules in the polyps form eight longitudinal rows; in each, two rows of needles are directed convergently towards one another, so that two always form an angle whose apex is directed towards the edge. The angle becomes blunter towards the apex of the polyp and at the base of the tentacles the spicules are placed in a peripheral ring. These spicules are slightly bent and curved with a few sharp warts, 0.46–0.025; 0.67–0.05 mm. The spicules of the diverging bundles are up to 0.83 mm. long and 0.07 mm. broad. The spicules of the tentacles are thin, with sharp spines and prickles, and are mostly thickened at one end, 0.2–0.025; 0.23–0.016; 0.33–0.05 mm.

*Habitat*.—Station 308, off Tom Bay, Patagonia; depth, 175 fathoms; bottom, blue mud.

#### 4. *Acanthogorgia ramossissima*, n. sp. (Pl. XXII. fig. 4; Pl. XXVI. fig. 7).

Colony upright, strongly and densely ramified. The stem rises to 145 mm., and has at its base a diameter of 3 mm. It is upright, somewhat flattened in one plane and spirally twisted in its course. The branches arise from three sides of the stem at short intervals of from 2 to 4 mm. In two opposite directions, in one plane they are strong, up to 2 mm. in thickness at the base and up to 50 mm. long; and these give off simple lateral twigs in two directions. Between these branches smaller branches arise in a median row, with small lateral twigs; they reach a length of 20 mm. All the branches form with the

stem angles of  $45^{\circ}$  to  $50^{\circ}$ , and are directed upwards, forming a thick bush. The polyps are large, cylindrical, expanded at the apex, 4 to 6.5 mm. long and 2 to 3 mm. in diameter at the mouth. The mouth is surrounded by eight large divergent bundles of spicules. The polyps project perpendicularly from the twigs. They form short spirals on the stem, which always consist of three polyps, each of which is separated by a distance of up to 2 mm. from the other. On the branches and twigs they are similarly arranged, only towards the summit they are more closely crowded. The cœnenchyma is thin, transparent. The axis is fibrous, soft, brown, in the thinner branches and twigs yellowish.

The spicules in the cœnenchyma are bent spindles which are placed close together and generally lie in the longitudinal direction of the axis. They are thickly covered with sharp spines, 0.4 mm. long and 0.04 mm. in diameter. There are in addition also smaller, strongly bent spicules, much thickened in the middle part, 0.2 mm. long and 0.18 mm. thick in the middle. In the polyps the large, spindle-shaped spicules are not so regularly placed as in the other species; it is not possible to distinguish eight rows, but the calcareous spicules lie thickly, placed over one another in various manners, and it is only at the end of the calyx that they form a distinct peripheral ring. They are thickly covered with fine, sharp spines, and are mostly more or less bent. They measure 1 mm. in length by 0.5 to 0.04 mm. in breadth. The spicules forming the eight bundles which surround the mouth reach 2 mm., and are either spindle-shaped and bent, or straight and somewhat thickened at one end, 0.5 mm.; they are always strongly warty. In the peripheral crown on the margin of the polyp there are triradiate spicules, 0.26 mm. in length, and also knee-shaped, bent, club-like bodies which bear on the convex bend two divergent processes, 0.25 to 0.05 mm. These forms call to mind those of the following genera. The colour of the colony in alcohol is yellowish.

*Habitat*.—Station 145, off Prince Edward Island; depth, 310 fathoms; bottom, volcanic sand.

## Genus 2. *Paramuricea*, K  lliker.

*Paramuricea*, K  lliker, Icon. Histiol., p. 136, 1865.

*Villogorgia*, Duch. and Mich., *emend.* Ridley, Ann. and Mag. Nat. Hist., vol. ix. p. 187, 1882.

*Paramuricea*, Verrill, *emend.*, Bull. Mus. Comp. Z  ol., vol. xi. p. 34, 1883.

This genus was originally established by K  lliker for some species of the old genus *Muricea*, Lamk. K  lliker diagnosed the genus as one in which "the polyp spicules formed large and well-developed opercular coverings upon the short, cylindrical calyces; the spicules sometimes conical-shaped, at other times with large prominences. The cœnenchyma spicules spindle-formed, with papilliform processes; either shorter or longer needle-like prominences projecting perpendicularly outwards or giving origin to three or four stellate forms, of which one ray is tooth-shaped."

*Muricea placomus*, Ehrbg., *Villogorgia nigrescens*, Duch. and Mich., and two new

species, *Paramuricea spinosa*, Köll., and *Paramuricea intermedia*, Köll., are placed by Kölliker in this genus.

Ridley (*loc. cit.*) believes that for this genus the name *Villogorgia*, given by Duchassaing and Michelotti,<sup>1</sup> in the year 1860, to a species of the genus of Kölliker, has the priority, and substitutes it for that proposed by Kölliker. He also therein includes *Paramuricea gracilis*, Studer, *Paramuricea borealis*, Verrill, *Boarella flabellata*, Gray, *Brandella intricata*, Gray, and as new, *Villogorgia mauritiensis*, Ridley. The substitution of *Villogorgia* for *Paramuricea* cannot be approved of, for the original diagnosis of Duchassaing and Michelotti was not only deficient but erroneous. The chief diagnostic character given by these authors is the absence of spicules, which is not a fact even in the case of some of the species described. So badly defined a generic name should not be employed for a genus, the species of which are distinguished in a marked manner by the peculiar manner and development of their body-spicules.

Verrill, in his account of the *Anthozoa* dredged by the "Blake" (*loc. cit.*), has also employed the name *Paramuricea*, and has characterised the genus as "Coral variously branched, often large. Cœnenchyma usually thick, filled with rough, fusiform and irregular spicula, some of which often project from the surface as small spinules. Calices short, cylindrical or verruciform, armed at the summit by a circle of short, projecting spinules, which are formed by the distal ends of large spicula having a large, irregular, flattened, usually lobed or flattened, basal portion, sides of calices with rough spicula, part of them irregular and flattened. Bases of contracted tentacles form eight triangular, convergent lobes, filled with spicula arranged *en chevron*; a circle of curved, transverse spicula surround the bases of these tentacular lobes."

Verrill places here species from the northern part of the Atlantic Ocean and from the Mediterranean, for the most part inhabitants of moderate depths. Besides the type (*Paramuricea placomus*, Ehrbg.), three new species from the east coast of America are included, also the following, formerly placed in *Acanthogorgia*—*Paramuricea grayi* (Johns.), *Paramuricea atlantica* (Johns.), and *Paramuricea hirta* (Pourt.), to which may be added *Acanthogorgia johnsoni*, Studer.

The genus is here accepted as emended by Verrill. Other species placed here by Ridley, as *Brandella* (*Villogorgia*, Ridley), *intricata*, Gray, and *Villogorgia nigrescens*, Duch. and Mich., are placed by us in a separate genus. The species of *Paramuricea* generally present large, upright, and for the most part strongly branched stems; the branching of which takes place in one plane. The axis is soft, translucent, horny, generally a little flattened on the thinner branches and very flexible. The cœnenchyma is not very thick. At the summit of the branches, which are somewhat thickened at their apexes, there are usually three to four polyps placed in different directions, none of them being placed directly on the termination of the branch.

<sup>1</sup> Coralliaires des Antilles, p. 32.

The polyps when extended consist of three portions, a basal portion armed with spicules, the calyx; an intermediate portion containing chiefly the œsophagus; and a tentacular portion which contains the oral disk and the eight pinnate tentacles.

When the polyp is retracted, the œsophageal portion, which contains no spicules, folds itself inwards, the tentacles bend together inwards over the oral disk, and the tentacular portion eventually assumes a position covering over the body; the margin of the oral disk sometimes completely withdraws itself, carrying in with it the basal portion of the tentacles.

The spicules of the cœnenchyma consist of spiny needles, sometimes with dentate prominences, which are sometimes straight, sometimes curved, or even bent at an angle. At the base of the calyx they are arranged in the form of a ring, and are furnished with spiny prominences, some of which become expanded, thus gradually taking the form called "Stachelplatten" by Kölliker. On the calyx itself they form converging series, which are arranged in eight longitudinal rows *en chevron*. The œsophageal portion has no spicules; they first appear under the base of the tentacles and form there a colleret of horizontally placed spicules. The base of the tentacles contains spicules placed in a longitudinal direction, but they only appear on the portion of the tentacle turned away from the mouth. These are elongated, spine-like; often a little bent, and mutually converging from either side. When the polyp is retracted, the colleret lies exactly around the upper edge of the calyx, and the spicules of the base of the tentacles form a covering over the calyx-opening, while the unarmed œsophageal portion is completely folded inwards.

There are three species in the collection of the Challenger, from the Atlantic Ocean and from the south-west coast of South America.

1. *Paramuricea æquatorialis*, n. sp. (Pl. XXII. fig. 6; Pl. XXVI. fig. 3).

The stem is branched in one plane, and is vertical. The branches are bent and curved in various directions. The principal stem has a length of 140 mm., its thickness at the base is about 3 mm., and it is somewhat compressed. The branches, of which some are equal in thickness to the principal stem, arise forming with it an obtuse angle, and opposite to each other. The larger ones develop lateral branches, which arise only on the side turned away from the stem. Branches of a third order are rarely developed, and are then but short. The stem and its ramifications form long unbranched tendril-like twigs, which are a little thickened at their terminal points; these latter are from 30 to 35 mm. long. The longest branch arising from the lower third of the stem has a length of 100 mm., and at its base it is 2 mm. in diameter; it gives off branches which also produce side twigs.

The polyps arise irregularly from the stem and branches in two or three rows but



never opposite, and are about 1 to 2 mm. distant from each other. The terminal points of the branches have a stolon-like appearance; three to four polyps, projecting divergently, are found immediately below these. The polyps stand out almost perpendicularly from the stem and branches, they are short, cone-shaped, 2 mm. high with the operculum, and 1 mm. in diameter. The spicules of the coenenchyma consist chiefly of large-bodied spiny spindles, which are often curved, and often quite bent into an angle, they have either short spines or small toothed prominences. They often, particularly towards the base of the body, present a somewhat flattened and curved form, whereby the spicules arrange themselves in the form of a ring. At the summit of the curve of such spicules two delicately toothed prominences occur. The average dimensions of the spicules are 0.38–0.06; 0.3–0.04; 0.29–0.03; 0.43–0.08 mm.

The spicules are arranged on the calycine portion of the polyps in a longitudinal fashion and in several layers. The lower layer contains flattened forms, which are furnished on one side with sharp-pointed prominences, on the other with spiny often branched prominences; the so-called "Stachelplatten." These measure 0.46–0.2; 0.38–0.25; 0.3–0.13 mm. Over these are spiny curved spindles, often thickened at one end, of which eight longitudinal rows surround the body; each row consists of two rows of spicules converging towards one another. These have an average size of 0.5 mm. by 0.05 mm. The colleret consists of curved spiny spindles placed ring-fashion. These are so arranged that the horizontal row of spicules always comes into contact with a row of the body spicules and with those at the base of the tentacles. They thus form supports for the spicules situated at the base of the tentacles, which latter present the form of long, pointed, spiny, and feebly bent spindles, of which from four to five lie at the base of each tentacle, with their points converging inwards and upwards. These reach a length of 0.7 mm. with a diameter of 0.58 mm. The retractile portions of the tentacles contain only needle-shaped, often feebly spined spicules.

The axis is horny, elastic, flexible, of a fibrous structure and of a yellowish-brown colour. The colour of the coenenchyma is (in spirits) of a greyish-white.

*Habitat.*—St Paul's Rocks, Mid Atlantic; depth, 80 fathoms.

## 2. *Paramuricea laxa*, n. sp. (Pl. XXVI. fig. 2).

In this species the stem is loosely branched in one plane, with long flaccid branches. The polyps, which are small and conical, arise principally from opposite sides of the stem and branches, leaving an intermediate space free, which is distinguished by a relatively smooth coenenchyma. The principal axis, which at its base is a little flattened, is variously curved and bent. It gives off on opposite sides an irregular series of small, simple twigs and larger branches, which latter have almost the strength of the main axis, and these end in long tendril-like drooping twigs. The larger branches give off twigs in

a similar manner as the chief stem, and these may again have simple lateral projections with unilateral polyps. Branches and twigs form between them angles of  $45^{\circ}$  to  $60^{\circ}$ . The height of the whole colony is about 120 mm., that of the principal stem is the same, of the larger branches 90 mm. The simple terminal twigs have a length of 40 mm. The diameter of the main axis at its base is 2.5 mm., of the chief branches 1 to 1.5 mm. The polyps are scattered on the stem and branches at intervals of 1 to 1.5 mm. They come off principally from opposite sides and leave the middle of the stem free; on the smaller branches they arise alternately from both sides. Towards the end of the branches they are placed closer, so that these appear thicker. At the ends of the branches there are usually three or four polyps from the one spot, diverging towards different sides. The form of the calyx, as compared with those of the previous species, is more cylindrical; the length with the operculum is 1.3 mm., the diameter 1 mm.

The arrangement of the spicules is the same as in the previous species; but their form differs materially. The spicules of the coenenchyma are spindles, curved, often with unilateral prominences or spines, there are sometimes also branched or forked as well as simply acerate forms of spicules. These measure 0.33 and 0.3 mm. The eight rows of "Stachelplatten" consist of spicules measuring as follows:—0.3–0.25; 0.23–0.16; 0.26–0.16 mm. The colleret is formed of strongly curved spiny spicules, measuring 0.38–0.33 mm. At the base of each tentacle, in the middle, is a straight spiny spicule, on which two curved spindles from either side converge, these have a length of 0.35; 0.3 and 0.25 mm. The axis is brown, fibrous and flexible. In the branches it is soft, so that these have quite pendulous terminations. The colour of the stem in spirit specimens is yellow; when dried it is white.

*Habitat*.—Station 310, Sarmiento Channel, Patagonia; depth, 400 fathoms; bottom, blue mud.

### 3. *Paramuricea ramosa*, n. sp. (Pl. XXVI. fig. 1).

In this species the colony is upright, expanded in one plane; fan-shaped. The principal stem gives off, quite close to the base, a large diverging branch at an angle of  $48^{\circ}$ , which has the same thickness as the principal stem. Each of the two then gives off, at intervals of 15 to 20 mm., large branched twigs and smaller simple lateral branches, which arise at angles of about  $45^{\circ}$ , giving the impression of a dichotomy. Towards the apex of the colony single branches anastomose with one another, in one instance the termination of a branch with the end of the main axis.

The thickness of the principal stem measures at the base 9 mm., that of the principal twigs 5 mm. The length of the simple branches varies from 15 to 20 mm. The coenenchyma is thin and forms, particularly towards the base, but a translucent covering. The polyps are short, conical, 1 to 1.5 mm. high, and 1 mm. in diameter at their base;

they stand out perpendicularly from the stem and its branches, at intervals of 1.5 to 2 mm. For the most part the polyps arise from both sides of the thicker branches and twigs, leaving an intermediate portion of the cœnenchyma free; towards the summit of the branches they arise more closely, and at the very extremity of these four or five are found clustered together so that the apices appear thickened. The spicules of the cœnenchyma are long, straight, or feebly bent spindles, thickly set with sharp spines and often with terminal knob-like swellings also covered with sharp spines; occasionally they are also curved with two diverging spiny prominences from their convexities. They measure 0.25–0.05 mm., and 0.5–0.07 mm. On the body there is an outer layer of club-shaped spicules, the thickened portion of which is armed with sharp spines; under this come the branched “Stachelplatten,” many of which have a very characteristic form. They consist of a broad root-like portion, from which branched spiny prominences project, and a thickened club-like portion armed with pointed spines. These measure, length by breadth—0.3–0.1; 0.4–0.2; 0.45–0.1; 0.22–0.06 mm. The colleret is formed of curved spiny spicules, the tentacular spicules are broad spiny spindles, of which the middle row is the largest; size 0.45 by 0.05 mm. The axis is soft, flexible, horny, fibrous, a little compressed on the main stem, and flattened on the terminal branches; it is of a yellowish-brown colour. While this species is very similar to the previous one, it will be easily distinguished from it by the form of the spicules.

*Habitat*.—Station 308, off Tom Bay, Patagonia; depth, 175 fathoms; bottom, blue mud.

### Genus 3. *Anthomuricea*, n. gen.

Colony with a branched stem and a horny axis. The polyps have cylindrically shaped calyces which stand out perpendicularly to the axis. These are supported by eight series of spiny spindle-shaped spicules placed *en chevron*, which are often more thickly packed at the apices. The basal portions of the tentacles constitute an eight-rayed conically projecting operculum; each of the eight rays is composed of many converging spiny spicules, which lie one above the other, and are placed *en chevron*.

The ordinary habit of the only species belonging to this genus corresponds more or less to that of a *Paramuricea*. The stem is upright, tree-like, and the branches are in one plane; the cœnenchyma is thin and on the more slender branches translucent. The polyps arise at somewhat wide intervals and stand in spirals of threes around the stem. The apex of a branch is never occupied by a polyp. Every polyp possesses a high, cylindrical and perpendicularly erect calyx. When the œsophageal portion is retracted the colleret assumes the position of a covering over the oral region. The eight basal tentacular portions form an eight-rayed conically projecting operculum. The whole polyp is clove-shaped. The spicules differ from those of *Paramuricea* in that no “Stachelplatten” are developed. The spicules of the cœnenchyma are curved or feebly

bent spindles, somewhat transparent and armed with numerous spines. In the body they often assume a more club-like form, one end becoming truncated and a little thickened; here they form eight rows, in each of which two spicules converge always together. Each of these rows subtends a tentacle. The colleret contains spiny, feebly bent, rod-like spicules which form a peripheral ring, the margin of which is composed of eight groups of spicules. The basal portion of the tentacles which forms the operculum is situated at the point of contact of two groups, formed from several rows of spicules converging upwards.

The axis is soft, horny, fibrous; the terminal branches are soft and pendulous.

*Anthomuricea argentea*, n. sp. (Pl. XXIII. fig. 1).

The main stem branched in one plane rises from a flat base; it consists of a principal stem with branches arising at angles, which do not give off branches in their turn, and there are four large branches which give off simple lateral twigs like the principal stem. The principal stem and branches are bent in various ways, the branches at their apices are soft and pendulous, at their terminations they are only slightly thickened. The main stem reaches the length of 400 mm., at the base it has a thickness of 5 mm. The small lateral branches are from 1 mm. to 20 mm. The large branches are 220 mm. in length and have a thickness of 3 to 4 mm. at their origin. The cœnenchyma is everywhere very thin and almost transparent. The hyaline spicules, which only form a thin layer, give it a silvery appearance. The polyps on the stem and branches are at intervals of from 2 to 2.5 mm. They are arranged spirally and so that three to four polyps form a spiral. They are cylindrical, rising perpendicularly 2 mm. high; 1 mm. constitutes the calyx, and 1 mm. the opercular portion near the colleret. The young polyps at the apex of the branches arise directly behind the blunt stolon which forms the termination of the branches and the twigs. The spicules of the cœnenchyma are chiefly curved spindles with short pointed spines; length by breadth 0.5–0.04; 0.3–0.05 mm. The calycine spicules assume a slightly club-like form and are in pairs, the blunt ends converging; the length by breadth of these spicules is 0.25–0.04; 0.3–0.05; 0.3–0.045 mm. At the colleret the spicules are feebly curved rods rounded off on both sides, and armed with delicate spines; length by breadth 0.58–0.03; 0.4–0.03; 0.33–0.025 mm. The basal portions of the tentacles which form the operculum are armed with at least from four to five rows of spicules placed *en chevron*, which have a spindle-like form and are feebly bent. Their length, taking those from the base to the termination of the opercular region, is 0.38–0.22; 0.2; 0.18; 0.16 mm. The axis is horny, fibrous, a little compressed, in the smaller branches it is soft and pendulous. Colour brown. The colour of the cœnenchyma is glistening white. The polyps are brown.

*Habitat*.—Station 307, off Port Grappler, Patagonia; depth, 140 fathoms; bottom, blue mud.

Genus 4. *Muriceides*, n. gen.

In this genus the colony is erect, slightly branched, with a thin cœnenchyma on which the large upright polyps rise at considerable intervals; the basal portion of their tentacular coronet is armed with strong spicules, and when in repose it is folded from about midway over the oral disc, its base forming a somewhat lofty operculum. There is also a ring-shaped colleret of spicules. The calycine spicules are irregularly placed, and here, as in the cœnenchyma, their terminal points project often as short rough needles.

The axis is horny and flexible. The only species at present known has a bifurcate stem, which arises from a flat basal expansion, growing on foreign bodies. It divides speedily into two forked branches, which are thickened at the apices into club-like forms. The cœnenchyma is thin and prickly, the latter owing to the numerous projecting points of the spicules.

The polyps stand at long intervals from one another; they are longer than broad, cylindrical, or bluntly conical, and with an elevated tentacular operculum, which seems to spring from the colleret. The spicules are in part spiny, in part flat, and often branched; "Stachelplatten" are also met with, with one termination pointed and the other broad, and with two or three spiny prominences. There are also curved spicules, with spiny and often branched prominences on their curvatures.

This genus comes between *Paramuricea* and *Clematissa*. The form of its spicules corresponds to that of those of *Paramuricea*, while the irregular arrangement of these on the wall of the polyps corresponds to that met with in *Clematissa*.

*Muriceides fragilis*, n. sp. (Pl. XXII. fig. 5; Pl. XXV. fig. 1).

In this species the short stem arises from a flat expansion of the basal portion, with a diameter of 1 mm.; at an elevation of 64 mm. it gives off a lateral twig, which is as thick as the main axis and is 80 mm. long; at its apex it is a little thickened. The cœnenchyma is rough, thin, though not transparent. The cylindrical, elongated polyps arise from the basal portion of the stem in isolated patches, and for an extent of about 11 mm. polyps are found; on the rest of the stem they are very few in number; they are in greater numbers on the branches, though even here at long intervals, and arising chiefly from one side.

The terminal portion of the branch is occupied by three polyps rising in same plane; none of which however form the apex. The calyces arise perpendicularly from the stem and branches; they are cylindrical or bluntly conical, 2 to 3 mm. high, with a diameter at the basal portion of 2 mm.

The tentacular operculum, which is 1.5 mm. high, is placed on a colleret of spicules.

The cœnenchyma and body spicules form a deep layer of long spindles, armed with pointed spines, 0.5 mm. long by 0.03 mm. in diameter, or 0.23 mm. by 0.12 mm. There are also broad flat spicules with simple or branched prominences, which often lie in different planes; and occasionally some spicules similar in appearance to the "Stachelplatten" met with in *Paramuricea*. The apices of these often project from the cœnenchyma and give it a roughened spiny appearance. These spicules measure 0.26; 0.35; 0.29 mm.; with a diameter of 0.06 mm. and more. Small, angular spicules with spiny prominences, which are more especially developed from the angles, have a length of 0.16 mm. The spicules in the tentacles are arranged in two converging series; they are simple spiny spindles of from 0.5 to 0.3 mm. in length.

The axis is horny, flexible, though brittle when dried as in *Paramuricea*. The colour of the stem is a dark brown, getting lighter towards the termination of the branches.

The cœnenchyma and the polyps are white.

*Habitat*.—Station 210, off the Philippine Islands; depth, 375 fathoms; bottom, blue mud.

#### Genus 5. *Clematissa*,<sup>1</sup> n. gen.

Like *Muriceides* in its habit, but resembling *Paramuricea* in its club-like thickened terminal branches, whose apices end in polyps. The spicules of the polyps are spiny, club-like, thickened at one end; not presenting the regular arrangement of those of *Paramuricea*. The basal portion of each tentacle, which is not retracted, contains two rows of converging, unilaterally thickened spicules.

The genus *Clematissa* shows in its habit a near relationship to *Paramuricea*. The three species included in it form large colonies branched in one plane, with long terminal branches, which at their apices are thickened and knob-like.

The cœnenchyma is thick, rough, and opaque. The polyps are arranged in short spirals on the stem and its branches; towards the termination of the branches they are closely crowded, so that they present a knob-like appearance. The termination of a branch is always formed by a polyp. The polyp calyces are bluntly conical, and rise for the most part upright from the stem and its branches. The œsophageal portion of the polyp, which in repose is retracted, is relatively short; there is always a colleret of spicules, arranged in a ring-form.

The tentacular portion, which is not folded inwards, is relatively large and armed with large converging spicules, so that the eight basal portions of the tentacles form over the oral region an eight-rayed conically projecting operculum.

The spicules of the cœnenchyma are stout, usually thickened, with a knob-like termination bearing asperities; sometimes armed with branched spines, sometimes

<sup>1</sup> κλημισσα.

forked, often bent, and showing a tendency in some cases to form "Stachelplatten." They are arranged irregularly on the cœnenchyma and on the polyp calyces, overlapping one another, and forming several layers. The colleret is composed of delicate needles arranged in the form of a ring, one row of which always forms the basal portion of the row of tentacles. In the tentacles the bent spiny spicules are always placed *en chevron* as in *Paramuricea*, so that two always converge together upwards. Spicules can be traced to the very apices of the tentacles.

The axis is always soft, horny and flexible, of a fibrous texture, with the ends of the branches usually drooping.

Of this genus, which is very nearly related to *Paramuricea*, three species are to be found in the Challenger collection, all of which were dredged in the South Atlantic.

1. *Clematissa verrilli*, n. sp. (Pl. XXII. fig. 10; Pl. XXVI. fig. 6).

The stem is upright, much branched in one plane; 360 mm. high and 300 mm. broad. The main stem arises from a flat, expanded, horny base; but it is soon diverted from its perpendicular course by the shooting out of a large lateral branch. The main axis next gives off on either side, at irregular intervals, large and small branches, which in their turn give off branches in a similar manner, and so on till branches of the fourth order are given off. The branches at first arise at almost right angles from the stem, bend soon in an upward direction, and then continue their course parallel with the stem; the small ones alone keep their original direction. The terminal portions of the branches and twigs are always knob-like. The diameter of the base of the stem is 8 mm., that of the larger branches from 4 to 5 mm. The length of the larger branches is 270 mm., of the unbranched terminal portions from 50 to 90 mm. The terminal twigs measure at their bases 1.5 mm., increasing to a thickness of from 4.5 to 5 mm. The cœnenchyma is thick and opaque.

The polyps are arranged all through in spirals, with intervals of 2 mm., they are erect, 2 mm. high, with a basal diameter of 2.5 mm. The basal portions of the tentacles form an operculum about 2 mm. in height. The arrangement of the spicules in the cœnenchyma and of the polyps is the same, and on this account the basal portion of the polyps is not very well defined.

The spicules of the cœnenchyma and of the polyps are thick and armed with spines, these latter are often branched, rarely with large, branched prominences. One extremity is usually knob-shaped, with a roughened surface. These measure in mm. 0.14-0.16; 0.50-0.16; 0.4-0.08; 0.46-0.1; 0.32-0.1. The spicules of the colleret are curved spiny spindles of 0.41 mm. in length and 0.04 mm. in breadth. Those of the tentacles are like shaped, of 0.33 mm. in length by 0.03 mm. in diameter.

The axis is soft, flexible, fibrous, horny; of a yellowish-brown colour. The

coenenchyma and the polyps in spirit specimens are brownish-grey, but white when dried.

*Habitat*.—Station 135, Tristan da Cunha; depth, 360 fathoms; bottom, volcanic sand.

2. *Clematissa robusta*, n. sp. (Pl. XXII. fig. 9; Pl. XXVI. fig. 5).

The stem is upright, loosely branched in one plane. The principal stem gives off branches at right angles, in alternating series on either side, and at long intervals. These branches stand off horizontally from the stem. The branches sometimes equal the stem in thickness, and sometimes surpass it in length. These give off single, perpendicular, lateral twigs which now and then anastomose with other branches; they sometimes, but rarely, give off secondary twigs. The unbranched terminal portions of the branches are long, tendril-like, and with thick knob-like endings; the length of the principal stem is 250 mm., with a diameter at its base of 7 mm.

The branches extend to a length of 240 mm. and over, with a basal diameter of 3 mm. The unbranched terminal portions of the branches reach to a length of 100 mm.

The polyps are spirally arranged on the stem and branches, at intervals of from 1 to 2 mm.; at the termination of the branches only are they closely packed. The polyps are about 1.5 mm. in height, with the same measurement for their basal diameter; the tentacular operculum is 1.5 mm. high.

The spicules in the coenenchyma and in the polyps are large, club-shaped, armed with branched spines, and often curved and bent; the club-shaped warty extremities project and give the polyps a rough warty appearance. These measure 0.5–0.12; 0.52–0.08; 0.62–0.1; 0.42–0.1; 0.54–0.067; 0.62–0.08 mm. In a deeper layer they are more spindle-shaped, and are packed close together, with their spines interlocking; these measure 0.6–0.07; 0.38–0.05; 0.3–0.04; 0.38–0.07 mm. The spicules of the tentacles are feebly bent spiny spindles.

The axis is horny, fibrous, soft, and very flexible, so non-elastic that the branches out of water droop loosely.

The stem is of a yellowish-brown colour. The coenenchyma and polyps in spirits are of a brownish-yellow, but when dried are yellow.

*Habitat*.—Station 310, Sarmiento Channel, Patagonia; depth, 400 fathoms; bottom, blue mud.

3. *Clematissa obtusa*, n. sp. (Pl. XXIII. fig. 2; Pl. XXVI. fig. 4).

The stem is feebly branched in one plane. The principal stem gives off, on one side only, two branches, which are either unbranched or very feebly so; the terminal twigs



are thickened, knob-like. Both stem and branches are flaccid. The length of the principal stem is 145 mm., of the leading branch 120 mm. The stem is 3 mm. thick at its base, the branches 2 mm. The thickened branch-endings have a diameter from 3 to 6 mm. In the early portions of the stem and branches the cœnenchyma is very thin; the polyps first appear at the upper portions, here they form closely packed spirals, with intervals of about 1 mm.; towards the apices of the branches they are closely crowded, and here the cœnenchyma becomes significantly thickened.

The polyps stand straight out from the cœnenchyma, and are almost cylindrical. The tentacles are completely retractile, so much so that the calyx on a front view seems quite truncated. The calyx is about 2 mm. high, with a basal diameter of 2 mm. The spicules are large spindles, often armed with warty branches and clubs; they are sometimes more or less bent, sometimes with branched prominences, which give rise to "Stachelplatten"; the club-shaped extremities often project from the surface of the polyp bodies. The spicules measure 0·5; 0·08–0·41; 0·08–0·41; 0·15–0·9; 0·2–0·5; 0·07–0·46; 0·1–0·8; 0·12 mm. Besides these large spicules, there are smaller spindles, often with bifurcate endings, and of 0·23 to 0·35 mm. in length. In the tentacles are found feebly bent spicules, rounded at one end, and thick with pointed spines at the other, 0·47 to 0·04 mm. long.

The axis is horny, fibrous, soft, and flaccid. The colour in spirits of the stem is brown, of the cœnenchyma and polyps a greyish-white, but white when dried. This species, from the habit of the polyps and the tendency of the spicules to branch, seems to lead to the following genus.

*Habitat*.—Station 311, off Port Churruca, Patagonia; depth, 245 fathoms; bottom, blue mud.

#### Genus 6. *Villogorgia*, Duchassaing and Michelotti (*emend.* Ridley, *ex parte*).

Duchassaing and Michelotti established this genus<sup>1</sup> for a Gorgonid from Guadeloupe, with the following diagnosis:—"Espèces rameuses dont la surface laineuse ressemble à du velours si on l'examine à la loupe. Avec le secours du même instrument, on n'aperçoit dans le cœnenchyme ni squames, ni spicules; les cellules sont saillantes; l'axe n'est point calcaire. L'absence de spicules et de squamules distingue assez bien le genre *Villogorgia* des *Muricea*, *Thesea*, *Acis*, &c." The only species described is *Villogorgia nigrescens*.

From a diagnosis like this, in which the absence of the spicules is so clearly set forth, one would scarcely be led to imagine that a Muriceid was referred to; and still, no doubt, the habit of the species, as represented in the drawing, at once reminds one

<sup>1</sup> *Memoire sur les Coralliaires des Antilles*, p. 32, pl. iv. fig. 2, 1860.

of a slender form of *Paramuricea*. This has also caused later investigators to include *Villogorgia nigrescens* amongst the Muriceidæ.

Ridley gives the name *Villogorgia* the priority over *Paramuricea*, and takes *Villogorgia nigrescens* as the type of the species of *Paramuricea* as definitely characterised by Kölliker.

An examination of the type specimen of the species described by Duchassaing and Michelotti establishes beyond a doubt that it is a true Muriceid. The branches, which are borne on a horny axis of a dark-brown colour, have the polyps cylindrical in shape, placed perpendicularly thereon; the polyp calyx, when retracted, is sunk down below the basal portions of the tentacles, which then form a low conical operculum. The cœnenchyma is thin, and armed with spicules, which are not closely crowded together, but are separated from one another by naked portions of the cœnenchyma.

The polyp calyx on the other hand appears thickly filled with spicules. The spicules of the cœnenchyma are four-, six-, or eight-rayed stars; in the polyp bodies there are for the most part tripartite spicules which are placed closely together, and the points of which interlock. The tentacular portion, which is very deeply drawn in, has at its base a colleret consisting of curved spiny spindles, placed as a ring upon which the tentacular operculum rests. This operculum is so formed that the portion of the tentacles which is not infolded is furnished with a series of two curved spicules, converging upwards; a third spicule is placed at the basal portion of the operculum, between the fork thus formed. The structure, it will be seen, differs in many important details from the diagnosis of the genus as given by Duchassaing and Michelotti; still the species cannot be placed in the genus *Paramuricea* of Kölliker, although no doubt there is a near relationship. The chief differences lie in the form of the spicules of the cœnenchyma, and especially in the structure of the tentacular operculum. In *Paramuricea* a larger portion of the basal portions of the tentacles form the opercular covering, and this is covered with whole rows of spicules placed *en chevron*. As nearly related forms there may be reckoned, as Ridley has rightly done, *Brandella intricata*, Gray; *Paramuricea gracilis*, Studer; *Villogorgia mauritiensis*, Ridley; and perhaps *Boarella flabellata*, Gray. Emended, the diagnosis of the genus may stand as follows:—

A Muriceid with a horny axis and a thin cœnenchyma; the polyps are cylindrical in shape, and placed perpendicularly on the stem. The tentacular operculum is shallow and conical; the spicules of the cœnenchyma are partly four- to eight-rayed stars, occasionally mixed with spindles. The polyp spicules are "Stachelplatten" and tripartite spindles. The basal portions of the tentacles which form the opercular covering contain a series of two spicules, converging to the apex, between which there is an odd intermediate spicule. There is always a ring-shaped colleret of spicules below the tentacles.

The known species are found in the tropical seas of both hemispheres at somewhat moderate depths.

*Villogorgia nigrescens*, Duch. and Mich., Guadeloupe.

„ *intricata*, Gray, Australian Seas.

„ *gracilis*, Studer, Bougainville.

„ *mauritiensis*, Ridley, Mauritius.

„ *flabellata*, Gray.

Of these only the following one is in the collection of the Challenger :—

*Villogorgia intricata* (Gray) (Pl. XXIII. fig. 3, *a*, *b*; Pl. XXVII. fig. 1).

*Brandella intricata*, Gray, Cat. Lithophytes Brit. Mus., p. 30, fig. 8, 1870.

*Villogorgia intricata*, Ridley, Ann. and Mag. Nat. Hist., ser. 5, vol. ix. p. 188, 1882.

The diagnosis of this species, which despite its transparent horny axis was in a very curious way placed by Dr. Gray among the Corals with calcareous axes, is emended by Ridley, who gives full details about the spicules.

The Challenger specimen agrees in all its details with the type in the British Museum, but it is a fairly complete specimen, while the original specimen only represents the fragment of a colony. The colony is upright, richly branched in one plane, with numerous branches whose terminal twigs sometimes anastomose. The principal stem arises from a horny base which grows over a stone; the base is cone-shaped; the main axis gives off near the base a large lateral branch, by which it is diverted from a vertical position and becomes slightly inclined to one side. The branches arise from both sides of the stem, at an angle of 50°, irregularly alternate, but more numerous on the convex side than on the concave. From the branches lateral twigs which stand off perpendicularly arise. Some bend after a short perpendicular course, and then run parallel with the branch; others run straight to the nearest branch, with which they anastomose. The branches often give off others of the second order, which behave similarly. The terminations of the branches and twigs which do not unite remain free for a considerable extent. The height of the colony is 125 mm., its greatest breadth is 150 mm. The length of the principal stem is 120 mm., that of the larger branches 100 to 110 mm. The thickness of the principal stem at the base is 3 mm., of the larger branches 1·5 to 2 mm. The free terminal branches reach to 20 mm.

The cœnenchyma is thin, on the older portions of the colony it is translucent. The polyps rise perpendicularly from the stem and branches, mostly from either side, and at irregular intervals of 1 mm. The termination of a branch is occupied by a polyp. The polyps measure 0·5 mm. in height by 0·54 mm. in breadth. The

spicules of the cœenchyma are four-rayed stars, and curved, broad spindles with spiny prominences, flattened, doubly pointed, curved, and giving off longish spines from the convex side; these measure, length by breadth, 0·21–0·08; 0·12–0·1; 0·10–0·06 mm.

The polyps are closely armed with broad spiny discoid spicules, generally triangular in form, with simple or branched lateral prominences. Length by breadth 0·15–0·05; 0·12–0·1; 0·13–0·12; 0·19–0·15 mm. Of the eight-rayed opercular covering, which closes in the calyx and corresponds to the basal portions of the tentacles, each ray consists of a base formed by a curved, spiny, and horizontally placed spicule of 0·15 mm. in length; upon this are placed two broad spicules, converging upwards, of 0·2 mm. in length; between these there is a fourth spicule laid down; if the lateral spicules are very broad, then this intermediate one is but short and thin; if otherwise it may extend to the tip of the opercular region. The axis is horny, flexible, elastic, longitudinally striate, in the thicker portions of a dark brown; in the thinner of a light-yellow colour. The colour of the colony in spirits is brownish.

*Habitat*.—Station 176, between the Fiji Islands and the New Hebrides; depth, 145 fathoms; bottom, Globigerina ooze.

#### Genus 7. *Echinomuricea*, Verrill.

*Echinomuricea*, Verrill, Proc. Essex Inst., vol. vi. p. 45; Amer. Journ. Sci. and Arts, vol. xlvii. p. 285, 1869.

Verrill, in 1869 (*loc. cit.*), established this genus for a Gorgonid from the Chinese Sea, which had already been briefly described by Stimpson, in 1855, as *Nephthya coccinea*. According to Verrill, the chief characteristic of this genus rests in the verrucæ being surrounded, at their base, by numerous very long, stout, thorny, and branched, spine-like spicules, which are crowded and somewhat imbricated, not placed in whorls.

The then only known species was *Echinomuricea coccinea* (Stimpson). A second species, *Echinomuricea indomalaccensis*, has been added by Ridley.<sup>1</sup> Ridley gives a very exact description of his new species. Without further emending the diagnosis of the genus, he suggests that *Acanthogorgia grayi*, Johns., and *Acanthogorgia atlantica*, Johns., may be included in this genus, but this is not so, as Verrill has shown under *Paramuricea* that both these species belong to this latter genus.

*Echinomuricea indomalaccensis*, Ridley (Pl. XXIII. fig. 4; Pl. XXVII. fig. 3).

*Echinomuricea indomalaccensis*, Ridley, Zool. Coll. H.M.S. "Alert," 1881–1882, 1884, p. 336, pl. xxxvi. figs. B–B'; pl. xxxviii. figs. d–d'.

The single specimen of this species in the Challenger collection agrees very well with the description of Ridley; the colony consists of an upright stem, branched in

<sup>1</sup> Zool. Coll. H.M.S. "Alert," 1884, p. 336.

one plane, of 200 mm. in height; the main axis has a thickness at its base of 2 mm., but the diameter of the terminal branches is nearly 4 mm. A principal stem can be distinguished, from which branches are given off on both sides; some of these attain the thickness of the principal stem; they are given off both at right and obtuse angles, soon bending upwards, and then running parallel to the chief stem. The branches sometimes bear lateral twigs, which in their turn give rise to smaller offsets, these are short and stand perpendicularly. In single branches a uniting or anastomosing takes place by obliquely uniting branches. The cœnenchyma which covers the horny, flexible axis, is thick, and towards the apices of the branches it becomes more so, so that the terminations of these appear quite club-shaped. The polyps, both on the stem and branches, are crowded all round the periphery, the polyps being at right angles to the stem; they are cylindrical, with upright truncated calyces. The opercular region does not project. The polyps measure 0·8 to 1 mm. in diameter. The spicules of the cœnenchyma are either spindles, with tubercles which are often branched, occasionally thickened at one end, or at both ends, and often also feebly curved, or some form lateral prominences, which are branched, with spiny tubercles. The spicules of the polyp calyx are very characteristic. These are pointed spindles, with expanded basal portions, which give rise to from two to six downwardly directed lobes, provided with simple or complex spines; the basal portions of these lie tightly packed over one another, like tubes, while the apices project and are often very conspicuous around the margins of the polyps. The opercular coverings are composed of thin, fusiform spicules, placed on the basal portion of each tentacle; three or four will be found converging towards the apex of each tentacle. While the spicules figured by Ridley fairly well represent those found in the Challenger specimen, yet it may be noticed that many have been observed by us with much more delicate and ornamented branches of the singular basal portions than are figured on pl. xxxviii. of Ridley's paper. The colour of our specimen is a dark red.

*Habitat*.—Station 203, off Panay, Philippines; depth, 20 fathoms; bottom, mud.

Genus 8. *Placogorgia*, n. gen.

Stem upright, branched in one plane, with a horny, flexible axis and a thick cœnenchyma, on which the polyps are arranged in narrow spirals. The polyps are short, cylindrical, and flattened on the oral aspect. The upper portions of the polyps, with the greater portion of the tentacles, can be quite withdrawn, being then covered over by the basal portions of the tentacles, which with their spicules form an operculum. The spicules of the cœnenchyma are warty spindles, often bent on their long axis. The polyp spicules are broad, warty "Stachelplatten," which lie over one another like scales; often these are replaced by irregular discs, whose surface is covered with papillæ and

their edges are divided into branched protuberances; they also present the form of triangular discs, with very expanded bases, which divide into several branched prominences, these are papilliform towards their apices. On the calyces these triangular discs are especially developed towards the margins, and their points project over these. The basal portions of the tentacles, which constitute the operculum, contain only two or three long, thin spicules, which lie near one another, so diverging that they rest with their basal ends on the colleret. The tentacles, when closed, do not come into contact basally with one another, so that an eight-rayed uncovered portion remains. About eight curved, spiny spicules placed peripherally, each one in contact with the basal portion of a tentacle, form a colleret. This genus, in the habit of the polyps, and especially in the form of the opercular covering, shows a near affinity to the preceding genus, while the form and arrangement of the "Stachelplatten," as well as their great development, show a relationship to *Acis*.

*Placogorgia atlantica*, n. sp. (Pl. XXIII. fig. 5; Pl. XXVII. fig. 2).

The habit of the colony reminds one of *Eunicella verrucosa* (?); from a flat base, which creeps over a stone, the upright stem arises; this gives off, in one plane, branches from both sides, which rise at angles of from  $45^{\circ}$  to  $90^{\circ}$ , they then bend in an upward direction, running parallel to the principal stem, again branching off in a somewhat similar manner. The last simple twigs often arise perpendicularly and terminate in little thickened knobs. The length of the principal stem is 336 mm., with a diameter of 4 mm. at its base. The larger branches reach a length of 120 mm., with a diameter of 2.5 mm. The length of the terminal branches is from 14 to 35 mm., with diameters, where they join the stem, varying from 1 to 2 mm., and from 2 to 3 mm. at the tips.

The polyps are evenly distributed over the stem, branches, and twigs in close spirals. On the terminal twigs the bases of the polyps come into contact. On the stem the polyps are depressed; on the branches they assume the form of blunt cones, with a diameter at their base of 1.5 mm. and a height of from 0.5 mm. to 1 mm. The mouth of the polyp seems truncated, in repose the polyps are quite retracted and the opercular coverings lie horizontally over the oral regions. The spicules of the coenenchyma are warty spindles, truncated at both ends, 0.38 mm. in length and 0.08 mm. in diameter, at first irregularly placed, they then become arranged in a ring-like form around the basal portions of the polyps; becoming at the same time feebly bent, also a little flattened and spiny, they are here 0.26 and 0.2 mm. long, with a diameter of 0.05 mm. On the calyces of the polyps the spicules take the form of large "Stachelplatten," with basal expansions, frequently branched; towards the oral region they appear pointed, that is, diverging into one or more points, others remain as broad plates, armed with branched spines on all sides. These spicules form three or four rows,

overlapping one another like tiles on a roof; the last row projects upon the oral region; they measure, length by breadth—0·37–0·33; 0·3–0·16; 0·5–0·4; 0·3–0·2 mm.

The colleret, which sinks within the margin of the calyx, consists of peripherally placed spiny spicules. The opercular covering is formed of two or three converging spindles, which are placed on the bases of the tentacles, and leave large interspaces, so that the oral region is imperfectly closed in. The opercular spicules measure 0·37 to 0·03 mm. The axis is transparent, horny, slightly flexible, of a light-brown colour. The cœnenchyma and the polyps when dried are white.

*Habitat*.—St. Paul's Rocks, Atlantic; depth, 80 fathoms.

### Genus 9. *Acamptogorgia*, n. gen.

Stem upright, branched, with a branched horny axis. Polyps short, at right angles to the stem; cœnenchyma very rough. The spicules both in the cœnenchyma and polyps are partly curved spindles, with irregularly branched spines; partly peculiar spicules with foliaceous expansions arising from a two- or three-rayed base. There is a colleret of curved spiny spindles. The bases of the tentacles are armed with a few long spiny spicules, which form a low cone-shaped operculum. The species have a general resemblance to those of *Villogorgia*; they form slender upright stems, branched in one plane, with relatively large polyps on the branches, arranged either in alternating series or in short spirals. The polyps have blunt, conical, warty calyces, within whose margin the collerets appear sunken. The tentacles in repose are quite infolded; their basal portions contain two or three converging spiny spicules, which form quasi-operculi over the oral regions. The spicules of the cœnenchyma are curved and bent spindles with jagged and frequently branched spines, which are more strongly developed on the convex sides than on the concave. The polyp spicules are remarkable: from the spindle-like bases one or two foliar expansions arise; in the least complex cases, and chiefly at the base of the polyps, these arise thus—a somewhat bent spindle is furnished with a dentate foliar expansion, from the margin of its convex side, the long axis of which stands a little obliquely to the long axis of the spindle. In most cases the spicule has become triradiate by the shooting out of several projections from about its middle. From the place where these rays centre one or two dentate foliar expansions arise, these latter stand at an acute angle to one another, and their long axes always fall into the angle between two of the rays. These spicules are so placed on the wall of the polyp body that the stellate rays are always inserted into it, while the foliar expansions project, scale-like, over the surface. The colleret consists of bent spindles, spiny, and upon which the opercular spicules abut. Each of the eight rays of the opercular covering consists of but three, fairly broad and somewhat flattened spicules,

<sup>1</sup> ἄκαμπτος, rigid.

with one end broad, and armed with spiny prominences ; the other pointed. The axis is horny and fibrous.

This genus stands in near relationship to *Echinogorgia*, Kölliker, but at once shows a difference in the more fully developed polyps and their opercular coverings, and further in the form of the spicules.

1. *Acamptogorgia arbuscula* (Gray, MS.) (Pl. XXIII. fig. 7 ; Pl. XXVII. fig. 5).

*Menacella arbuscula*, Gray, *in litt.*

Under the title of *Menacella arbuscula*, Gray, the Natural History Department of the British Museum possesses the dried branch of an Alcyonarian which agrees in every detail with a species in the Challenger collection ; the label attached to a portion of Dr. Gray's specimen, which had been communicated to one of us, is in Dr. Gray's handwriting ; still it is difficult to understand why he should have placed it under the genus *Menacella*, as this genus was characterised by Gray himself as having "polyp cells covered with spicules like the bark," and those of the "bark" were described as "very slender fusiform spicules." Ridley also, who has investigated the type of *Menacella* (*Menacella reticularis*), confirms the statement that this genus has only simple spindles. The present species therefore cannot remain under the genus *Menacella*, and for it as a type the present genus has been established.

The colony has an upright stem, branched in one plane, with long branches at considerable intervals. The principal stem arises from a smooth expanded base to a height of 270 mm., it has a diameter at the base of 3 mm., gradually narrowing to one of 1.5 mm. On both sides, at angles of 45° to 60°, larger and smaller branches, almost opposite to one another, and at varying intervals, arise, which in part remain simple and reach to lengths of 15 to 20 mm., and in part are developed to a length of 120 mm., and then, in a similar manner to the principal stem, give off branches until these again develop branches of a fourth order. The larger branches have at the base a thickness of 1 to 2 mm.; the terminal branches one of 0.6 mm. The apices of the branches seem a little thickened at their terminations, having a diameter of 2 mm. The cœnenchyma is rather thick and rough. The polyps stand in spirals of three or four on the stem and branches, at intervals of 1 to 1.5 mm., but at the apices of the branches they are more closely packed and their bases are contiguous. The young polyps arise on the apices of the twigs. The shape of the polyps is cylindrical or bluntly conical, they are fixed at right angles on the branches. The operculum forms a low cone. The basal diameter of the polyps is 1.5 mm. with a height of 0.8 to 1 mm. The spicules of the cœnenchyma are bent, spiny, papilliform spindles, frequently with short foliar expansions from their convex portions ; 0.2 mm. in length ; 0.1 mm. in thickness with the foliar expansions, or 0.3 mm. in length, and 0.1 mm. broad. On the



calyces the spicules consist of three-rayed stars, with intervals between the points of the rays of 0.21 and 0.25 mm.

The foliar expansions of these spicules are chiefly two, which form an acute angle with one another, and have a height of 0.2 and 0.13 mm. The colleret is formed of curved roughened spindles of 0.26 mm. in length, and 0.04 mm. in breadth; those forming the operculum are flat, with marginal branching spines, truncated at one extremity, and more pointed at the other; 0.47 in length and 0.07 mm. broad. The axis is horny, brown, not longitudinally striated, slightly flattened on the stem portion, it is flexible in the slender branches, and soft. The colour of the stem in spirits is brown. The oral regions of the polyps are of a violet hue, owing to a corresponding coloration of the spicules of the colleret and of the opercular region.

*Habitat*.—Station 232, the *Hyalonema*-ground, Japan; depth, 345 fathoms; bottom, green mud.

2. *Acamptogorgia alternans*, n. sp. (Pl. XXIII. fig. 6; Pl. XXVII. fig. 4).

The colony consists of a low and slightly branched little stem, 90 mm. in height, somewhat flattened, which gives off branches on both sides, at angles of from 70° to 80°, which are again furnished with simple unbranched twigs. The branches either go straight off from the stem, or bend after a little upwards, and then proceed parallel to the principal stem. The length of the largest branches is 50 mm.; of the simple branches 15 mm. The diameter of the chief stem at its base is 3 mm.; of the larger branches 1.5 mm. The terminal branches become thickened towards the apex up to 2 mm. in diameter. The cœnenchyma is thick and rough. The polyps are sparsely scattered on the stem; they are more closely placed on the branches and twigs; they stand at right angles to the stem, at opposite sides, in alternating series, and at intervals of from 1 to 1.5 mm. At the apices they are closely crowded. The form of the polyp calyx is that of a blunt cone. The diameter of the base is 1 mm., the height 1 mm. The opercular region is low and conical. The spicules of the cœnenchyma and polyps are alike, as in the former species. In the cœnenchyma they are more spiny, and there are curved spindles, frequently with foliar prominences. Length 0.3; 0.21; 0.4 mm., with a diameter of the spindle of 0.06; 0.08; 0.023 mm. In the calyx there are triradiate spicules, with the third ray shortened, and with a bifoliar appendage with dentate margins; the rays measure 0.33; 0.38; 0.3; 0.16 mm.; height of the foliar expansions 0.16; 0.25; 0.22; 0.23 mm.; long diameter of an expansion 0.16; 0.25 mm. The colleret contains long curved spicules with few spines, of 0.5 mm. in length, and 0.04 mm. in breadth, and 0.46 long by 0.044 mm. broad. The opercular spicules are flat, spiny, armed at one end with smooth projections, towards the other they are more pointed; they are 0.39 mm. long by 0.06 mm. broad.

The axis is horny, feebly flexible, as in the former species, and of a yellow-brown colour. The colour of the stem, in spirit specimens, is whitish.

*Habitat*.—Kandavu Reef, Fiji.

#### Genus 10. *Echinogorgia*, K  lliker.

*Echinogorgia*, K  lliker, *Icones Histologic  e*, vol. i. p. 136, 1856.

Professor K  lliker separated this genus from *Muricea*, and characterised it as consisting of "Primnoids with a horny axis, with small spiny spicules of a peculiar form; and polyps scarcely at all prominent." K  lliker places in this genus Esper's *Gorgonia sassapo*, *Gorgonia umbratica*, *Gorgonia purpuracea*, and *Gorgonia cerea*. *Gorgonia sassapo*, var. *reticulata*, Esper, is also included under the new name of *Echinogorgia pseudosassapo*, K  ll.

Verrill, in his Notes on Radiata,<sup>1</sup> adds also to these species *Leptogorgia aurantiaca*, Milne-Edwards, from Callao. A new species, *Echinogorgia intermedia*, Studer, is described by Studer in the Alcyonaria of the voyage of the "Gazelle."<sup>2</sup> Lastly, Ridley thinks<sup>3</sup> that *Antipathes flabellum*, Esp., = *Gorgonia cancellata*, Dana, should be placed in the genus, an opinion in which we concur.

All the above-enumerated eight species, with the exception of *Echinogorgia aurantiaca*, have been examined by us; all present upright colonies, for the most part branched in one plane. The branches are either free or anastomosing into a network. The axis is horny, sometimes flattened. The c  enenchyma is thick, not transparent. The polyps are small, but slightly prominent, papilliform, and usually in close spirals surrounding the stem. The operculum is, for the most part, feebly developed, and is sunk within the margin of the polyp calyx, over which it does not project. It is formed by two or three spicules at the base of each of the tentacles. The spicules of the c  enenchyma and of the polyps are very numerous. K  lliker describes them as unilateral spiny spindles, one-sided spiny clubs, echinulate discs, warty spindles, and double stars. Besides, there are also peculiarly formed "Blattkeulen," whose dentate folia project beyond the c  enenchyma, and give it a roughened prickly appearance. In the different species, sometimes one and sometimes another form of these spicules will be found to predominate. In those with a well-developed c  enenchyma, where the polyps are somewhat apart from one another, the one-sided spiny spindles predominate; while in others, with closely packed polyps, the "Blattkeulen" or the spiny discs are present. The axis is always horny and frequently compressed. All the species at present known belong to the Indo-Pacific Seas.

Two species were in the Challenger collection.

<sup>1</sup> *Trans. Connect. Acad.*, vol. i. pt. ii. p. 418.

<sup>2</sup> *Monatsber. d. k. preuss. Akad. d. Wiss. Berlin*, October 1878, p. 651.

<sup>3</sup> *Zool. Coll. H.M.S. "Alert,"* p. 337.

1. *Echinogorgia pseudosassapo*, K  lliker (Pl. XXIII. fig. 9 ; Pl. XXV. fig. 5).

*Gorgonia sassapo*, var. *reticulata*, Esper, Pflanzenthier, 1791, Taf. viii.

*Echinogorgia pseudosassapo*, K  lliker, Icones Histologic  e, vol. i. p. 136.

There can be no doubt about the identity of the Challenger specimen with *Gorgonia sassapo*, var. *reticulata*, Esper, after a comparison of Esper's drawing and of the spicules illustrated by K  lliker (*loc. cit.*). The colony presents an upright stem, richly branched in one plane, the smaller branches of which frequently anastomose with one another, and so form a loose network. The main stem rises from a flat expanded base to a height of 170 mm., with a diameter of 4.5 mm., and gives off branches on both sides, in alternating series, which, arising at an acute angle, either take a course at right angles, or, bending upwards, take a direction parallel to the principal stem and with their apices reaching its level. Their length is from 100 to 120 mm. Their basal thickness 2.5 mm. Twigs arise from the branches, as well as from the principal stem, which are given off at almost right angles, and which either anastomose with some of the other branches and thus form a network, or terminate as simple knobs, or finally bend in order to run parallel to the main branch, and then give off in their turn, short, lateral, knob-like endings. The length of the simple terminal branches is about 16 mm., with a thickness at their commencement of 2 mm., increasing to 2.5 mm. at their ends.

The c  enenchyma is thick and rough on the stem and branches. The polyps on the stem and branches are in closely packed spirals ; they form but small, wart-like projections, with longish oval, slit-like mouths. The tentacles are quite retractile, and there is but a feebly developed operculum, which does not project beyond the margin of the calyx. The polyp is at most 1 mm. in diameter, with a height of 0.5 mm. The spicules are in part peculiar spiny discs of a triangular shape, armed with warts as figured by K  lliker in this species,<sup>1</sup> having a length of 0.63 mm., and a breadth of 0.18 mm.; there are others with from three to four branched prominences and with a usually tri-foliate expansion, which is either flattened out or is again trifurcate. These spicules measure, from the root to the apex of the foliar expansions, 0.24, 0.25, 0.21 mm., with a breadth for the foliar expansions of 0.14, 0.2, and 0.13 mm. Besides, forms occur which remind one of the spicules of the polyps of *Paramuricea*; multirayed stellate forms, from which a smooth pointed ray goes off. Lastly, there are spindles, frequently curved and unilaterally rayed, of a length by breadth of 0.16–0.05; 0.25–0.07 mm. Both the foliar expansions and spines project beyond the surface of the c  enenchyma and of the polyps and give these a roughened appearance.

The opercular portions are formed by short, smooth spines, of which two or three are found on the bases of each tentacle. All the spicules are of a dark-red colour.

<sup>1</sup> *Loc. cit.*, pl. xviii. fig. 10.

The axis is horny, flexible, elastic, brown. The terminal branches are yellowish. The general colour of the colony is a dark coral red.

*Habitat*.—Torres Strait.

2. *Echinogorgia ramulosa* (Gray) (Pl. XXII. fig. 8; Pl. XXV. fig. 6).

*Bovella ramulosa*, Gray, Ann. and Mag. Nat. Hist., ser. 4, vol. v. p. 407.

*Echinogorgia ramulosa*, Ridley, Zool. Coll. H.M.S. "Alert," p. 339.

Dr. Gray first named this species, which he made the type of his genus *Bovella*, described as "Coral branched, fan-shaped, expanded into an oblong frond, stem simple; branches and branchlets slender, of the same diameter throughout; branches radiating and irregularly furcately divided, with abundance of short branchlets arranged rather pinnately and diverging at nearly right angles, forming a more or less regular network; many of the branchlets, especially the marginal ones, free. Bark furfuraceous, formed of very small soft spicules or thin scales. Polype-cells circular, prominent, with a sunken centre and a furfuraceous surface, placed on all sides of the branchlets and on the internal surface of the branches. Axis continuous, horny, black." The natural affinity of this form was not at all clear from Gray's description, which serves also as the diagnosis of the genus.

Ridley, who (*loc. cit.*) had the opportunity of comparing the supposed type specimen in the British Museum, refers the species to *Echinogorgia*. One specimen in the Challenger collection fairly agrees in its general characters with Dr. Gray's species, so that it is here described under the same specific name.

The species is left in the genus *Echinogorgia*, although it differs in some of its characters from the typical species of this genus. The polyps are more prominent than in any of the known species; further, their distribution on the stem and the branches is peculiar, while they are well developed on one surface of the stem; on the other, the plain cœnenchyma is alone met with. Of the spicules, the one-sided spiny spindles and discs predominate, arranged in the cœnenchyma like a pavement; by which fact this species may be distinguished from *Echinogorgia flabellum*, to which species Ridley would apparently unite it. The stem, which is upright, is richly branched in one plane, expanded into a cup-shaped form, but with free branches and twigs. The whole colony reaches to a height of 125 mm., with a breadth of 160 mm. The principal stem is a little bent, almost at its base, to the one side, and immediately gives off, on both sides, smaller and larger branches, alternating at an angle of 45°. The length of the principal stem is 80 mm., with a diameter of 4 mm. at the base; that of the branches 60 to 100 mm., with a basal diameter of 3 mm. The branches give off twigs in a similar manner to the principal stem, at angles of 45°, which have lateral branches, terminating with slight thickenings. The last free branches have a length of 10 to 16 mm., with a

diameter of 2 mm. at their commencement and 2·5 mm. at their thickened ends. The stem and branches are not cylindrical, but flattened on the two sides, so that the longer diameter comes in the plane of the expansion of the stem. The cœnenchyma is thick and rough. The polyps form prominent, blunt, conical warts, with a basal diameter of from 1 to 1·5 mm. They have a conical operculum. The polyps are found all over the surface of the twigs and finer branches; on the larger flattened branches they occur only on their shorter diameter; while on the main axis one surface alone has polyps, the other having none. The spicules of the cœnenchyma are smooth spindles, placed close to one another, their long axis parallel to that of the stem; one end of the spindle terminates in wart-like protrusions, with dentate margins, which intercalate with those of the adjoining spindle; the other is expanded into irregularly shaped longish discs, with dentate margins and warty surfaces. Their length by breadth is 0·33-0·08; 0·3-0·1 mm. The spicules are arranged peripherally round the base of the polyps, usually in two rows; their dentate surfaces projecting beyond the cœnenchyma and giving it a spiny appearance. These one-sided spiny discs and spindles, when viewed in profile, remind one of a hairy caterpillar, or still more of an *Æolis*; their length is 0·6 mm.; the spiny warts are 0·13 to 0·25 mm. long. On the polyps the spiny portion of the spicule is more strongly developed, and there are spiny discs 0·3 mm. long by 0·2 mm. broad; towards the margin of the calyx stellate spicules, with projecting smooth spines, are met with. From the projecting portions of these spicules, which lie over one another like tiles on a roof, a roughened appearance is given to the calyces. Spindle-shaped spicules, at the base of each tentacle, with spiny margins, form the opercular covering; there are three spicules at the base of each tentacle, 0·26 mm. long and 0·06 mm. broad; they rest on a well-developed colleret of curved and peripherally placed spindles, which can be withdrawn within the margin of the body.

The axis is horny, fibrous, of a black colour in the stem, but a light brown on the thinner branches.

*Habitat*.—Station 201, Philippine Islands; depth, 120 fathoms

#### Genus 11. *Acis*, Duchassaing and Michelotti.

*Acis*, Duch. et Mich., Mém. Corall. des Antilles, p. 19, 1860; Suppl. Mém., p. 14, 1864.

„ Kolliker, Icones Histiologicæ, p. 136, 1865.

„ Ridley, Ann. and Mag. Nat. Hist., ser. 5, vol. x. p. 126, 1882.

This genus was established by Duchassaing and Michelotti for a West Indian species, conspicuous for the great development of the spicules. The diagnosis given in the Supplement, which includes two species, is:—“*Polyparium ramosum, cortice e spiculis magnis fusiformibus nudis vel etiam in superficie squamulis deciduis formato*;

(Zool. Chall. Exp.—PART LXIV.—1887.)

Sss 16

cellulis squamosis, remotis, subalternis, pustulæformibus; ore terminali radiato." Kolliker, from an examination of one of the species (*Acis guadalupensis*, D. and M.), gives some details of the spicules, and notes that while a prominent operculum is wanting, yet that the spicules at the base of the tentacles serve the purposes of one. For a long time no additions were made to the genus, one species of which, *Acis nutans*, Duchassaing and Michelotti, seems not to be a Muriceid at all, but in 1882 Ridley (*loc. cit.*) described a species from the Indian Ocean (Mauritius) as *Acis orientalis*, Ridley. A species closely related to the first and the last mentioned occurs in the Challenger collection. In general habit the species of this genus differ from that of the other Muriceids. The colony consists of a stem, branched in one plane, on which the branches as a rule keep the one thickness throughout. The polyps are small, with wart-like bodies usually placed at long intervals on the sides of the branches and twigs. The cœnenchyma is armed with extraordinary large spiculés, of the form of either smooth or warty spindles, of which some six or seven, placed side by side in a longitudinal manner, surround the periphery of the stem and the branches. These spicules often reach to a length of 1 to 3 mm., so that they are quite perceptible to the unassisted eye. Duchassaing and Michelotti allude to a layer of small scale-like deciduous spicules lying over the large spindles, but no such layer exists in the East Indian species, nor is any trace of it to be found in the type specimen of *Acis guadalupensis* in the Turin Museum, nor is it alluded to in the first diagnosis of the genus.

On the polyps the spicules are smaller, forming rings round their bodies. These calcareous spicules are scale or disc-like.

The spicules on the basal portions of the tentacles form a more or less well-developed operculum. The genus in some respects seems closely related to the previously described species of *Echinogorgia*, and also with those species of *Muricella* which are armed with large spindles.

*Acis pustulata*, n. sp. (Pl. XXIV. figs. 1, 1a; Pl. XXVII. fig. 6).

The colony is upright, branched in one plane; 97 mm. in height and 110 mm. in breadth. The principal stem rises with a wavy outline, giving off on either side larger and smaller branches, which come off at an angle of 50°, and in their turn also give off large and small twigs. The larger branches give off small undivided branches, coming off laterally at right angles. The stem and branches are compressed in the plane of the branches, and are throughout of about the same thickness. The terminal branches are somewhat thickened at their apices. The branches frequently bend round in their course and then run parallel to the stem; in one instance there is an anastomosis of two branches. The height of the principal stem is 86 mm., of the larger branches 87 mm., of the terminal branches 16 mm. The principal stem has a basal diameter of 3.5 mm.,

the larger branches one of 2.5 mm., the terminal branches have a basal diameter of 1.5 mm., and an apical one of 2.2 mm. The cœnenchyma is thin, but provided with a layer of large spindle-shaped spicules. The polyps are found chiefly on one surface, and on the margins of the stem and of the twigs of the colony, while the other portions of the surface are covered only with the cœnenchyma. The distance between the polyps is from 1 to 1.5 mm. On the thickened and flattened ends of the branches there are two opposite polyps. The polyps present an erect, wart-like body, with a broad base of a diameter of 1.5 mm., and a height of 0.8 mm., they are closed by an imperfect operculum. The spicules are mostly discernible by the eye. In the cœnenchyma they are somewhat flattened spindles, whose margins are furnished with dentations, which can intercalate with those of the neighbouring spicule. Sometimes, especially towards the base of the polyps, they expand into longish discs truncated on both sides, or running out into short prominences. Their surfaces are covered with rough wart-like protuberances. The longest spicules have a length of 3 mm., with a diameter of 0.2 mm.; others measure 1.3–0.5; 0.9–0.3 mm. On the polyps the spicules are discoid, arranged in the form of a ring, sometimes triangular, sometimes rhomboidal; towards the margin of the calyx they are scale-like, and the protuberances often take the form of comb-like teeth. Their thickness differs very much; their length by breadth is 0.9–0.3; 0.4–0.3 mm.

The operculum is formed of smooth, scaly and dentate spicules, which are found in the basal portions of each tentacle; these are at once distinguished by their violet colour, which contrasts with the white spicules of the body. Sometimes these are spear-shaped; sometimes they remind one of the Stachelplatten of *Paramuricea*. Their length by breadth, *i.e.*, the greatest diameter, is 0.54–0.41; 0.4–0.2; 0.26–0.07; 0.2–0.05; 0.33–0.16 mm. An incomplete ring of curved blunt spindles forms the collar. The axis is horny, rigid, and of a brownish-yellow colour; it is very feebly flexible. The colour of the cœnenchyma and of the polyps is white, but the oral region is of a dark violet. From *Acis orientalis*, Ridley, to which this species is nearly related, it may be distinguished by the form of the spicules and by the compressed stem.

*Habitat*.—Station 232, the *Hyalonema*-ground, Japan; depth, 345 fathoms; bottom, green mud.

## Genus 12. *Muricella*, Verrill.

*Muricella*, Verrill, Trans. Connect. Acad., vol. i. p. 450, 1869.

Verrill (*loc. cit.*) subdivides the genus *Muricea*, as emended by Kölliker, into three divisions. One, *Muricella*, comprises the East Indian species; the species of the other two, *Muricea* and *Eumuricea*, being chiefly limited to the Atlantic Ocean and to the West American coasts. But *Muricella*, at least, differs so much from the others that we feel justified in keeping it generically apart; a conclusion adopted by Ridley.

Verrill characterises the section, "species which have a rather thin cœnenchyma, filled with long spindles; with low subconical verrucæ arising from between the large spicula and usually standing at right angles to the surface, and covered with much smaller and shorter spindles." He places in it *Muricea flexuosa*, Köll., *Muricea nitida*, Köll., *Muricea humosa*, Köll., *Muricea tuberculata*, Köll., here also belongs *Muricea umbraticoides*, Stdr.

### 1. *Muricella tenera*, Ridley.

*Muricella tenera*, Ridley, Zool. Coll. H.M.S. "Alert," 1884, p. 335, pl. xxxvi. figs. E, E', e, e'.

One specimen in the Challenger collection agrees well with Ridley's description, the few differences to be noticed being doubtless owing to our specimen being very well preserved in spirits. The colony is erect, spreading; branches either simple or at a little distance from the stem becoming irregularly pinnate, arising in one plane. Polyps in two rows, on the front or side of the main stem or branches; the termination of the branches with two polyps opposite one another, giving a triangular appearance to the apex; the axis of growth of the main stem or branches is truly terminal, and as it elongates, the polyps become alternate. In the Challenger specimen, apparently only a fragment, the main stem is 70 mm. high; the principal branches extending to a length of 65 mm. Diameter of the main stem 3 mm., and the same for the principal branches. The large polyps, well figured by Ridley, are upright, shaped like a truncated cone, whose margins are produced into eight triangular flaps. The oral region is protected by a covering, formed out of the basal portions of the tentacles, which contain spicules. In the figure given by Ridley, the body is represented as surrounded by spicules, which extend the whole length of the calyx, and the tips of which form the margin; in the present specimen, the spicules are arranged round the polyp, in many rows, from the base to the above-described margin. Some may object to the form being placed under *Muricella*, and may think it has a closer affinity to *Anthogorgia*, Verrill. Dr. Coppinger's specimens were found at Port Molle, Queensland.

*Habitat*.—Station 192, off the Ki Islands, south of Papua; depth, 140 fathoms.

### 2. *Muricella umbraticoides*, Studer.

*Muricella umbraticoides*, Studer, Monatsber. d. k. Akad. d. Wiss. Berlin, 1878, p. 650, pl. iii. fig. 16.

The small-sized axis of this species is symmetrically branched in one plane, and is about 75 mm. high. Ridley, who received the species from Port Curtis and Port Molle, thinks the description given by Studer of the spicules is not quite exact; he says "the 'halbseitig warzig' character of the spicules appears hardly to exist, and the tubercles should be rough and more distinct from each other than his otherwise good



figure would signify." Nevertheless, in the thick spindles which are found in the coenenchyma, the one side has decidedly larger warts than the other side.

*Habitat*.—Station 190, Arafura Sea, south of Papua; depth, 49 fathoms; bottom, green mud.

### 3. *Muricella complanata*, n. sp.

Colony ramified in one plane, with an upright stem giving off branches on two sides at angles of about  $45^\circ$ ; these branches again bear twigs which come off straight. The stem and branches are flattened in the plane of ramification. The polyps have projecting, truncatedly conical calyces, which stand out at right angles from their support. They arise in alternating series from the edges of the stem and branches.

The height of the colony is, in the case of the single specimen found, 250 mm.; the greatest width is 125 mm. The diameter of the main stem is 4.5 mm. near the base, and 4 mm. in the middle. The larger branches have almost the same thickness and attain a length of 170 mm. The first branch arises at a height of 32 mm. The main stem rises from an encrusting base to a height of 250 mm., bending many times in its course, but always in the plane of ramification. This is caused by the coming off of the larger branches, which always cause a deviation of the growth in the opposite direction.

In its lower part the stem is still almost cylindrical, with the origin of the larger branches it becomes flattened in the plane of ramification. Four larger branches arise in alternating series from both sides of the stem at angles of  $45^\circ$  to  $60^\circ$ ; they are almost of the same thickness as the stem (3 to 4 mm.), flattened in the same plane and exhibiting a similar course. They generally give off secondary branches at from acute to right angles; these either remain simple or again bear short twigs. The secondary branches often bend after a short course and run more or less parallel to the main branch. Like the branches the main stem also gives off, especially in the upper half of its course, simple secondary branches, coming off at right angles, which only rarely again bear short twigs. The distance between the origin of the main branches reaches 12 to 25 mm. The secondary branches arise at intervals of 15 to 20 mm. and more. The twigs are 12 to 25 mm. long and 2 mm. thick. The stem, branches and twigs remain of the same thickness up to the terminations, which become expanded to a thickness of 4 mm.

The polyps arise in alternating series from the edges only of the stem, branches and twigs, and leave the broad surface of the branches free. They are placed at distances of 1 to 1.5 mm. from one another. The calyx, from which the tentacular operculum scarcely projects, is truncatedly conical, somewhat narrowed in the plane of ramification. The diameter of its base reaches 2 mm., and its height 1 mm. The end of the twig is usually occupied by two divergent polyps, between the bases of which a small, blunt process projects which forms the apex.

The cœnenchyma is relatively thick and not transparent. It is filled with large, thick, warty spindles, which, placed close together, form a continuous covering. The spindles are usually simply curved or slightly S-shaped, frequently blunted and thickened at one end so as to become somewhat club-shaped. They are thickly covered with rough warts, whose surface is prickly and often even covered with little branching spines. In the centre of the spicules the warts come off at right angles, at the ends they are directed towards the apex. The spindles are placed in the long axis of the stem and branches, around the base of the calyx they form a ring. The size and thickness, as well as the shape, are very variable. Size:—1.25 by 0.25; 1.5 by 0.2; 1.2 by 0.2; 0.94 by 0.13 mm. These spicules form only a single layer in the cœnenchyma.

The spicules of the calyx are shaped like those of the cœnenchyma, generally more rounded off towards the base, and pointed towards the margin. They stand vertically upon the spicules of the cœnenchyma and are arranged in eight groups. Each group consists of two rows of spicules converging towards the margin of the calyx; at the base they diverge from one another and at the margin they form eight projecting teeth. They measure 0.63 by 0.1; 0.58 by 0.13; 0.41 by 0.12 mm. Their surfaces are usually less thickly tubercled. In the spirit specimen the calycular operculum forms on many of the calyces a conical process; the bases of the tentacles, constituting the operculum, are formed of several spindle-shaped spicules arranged "*en chevron*," whose size gradually decreases from the base of the tentacle upwards. The colleret is feebly developed, being only a ring of slightly curved spicules. The spicules of the operculum are straight or slightly curved spindles, covered with simple, vertical wartlets; they measure 0.41 by 0.05; 0.38 by 0.042; 0.37 by 0.033; 0.16 by 0.05; 0.28 by 0.09 mm.

The axis is thin, flexible and horny; in the thicker branches black and in the twigs yellowish. The cœnenchyma is, however, so packed with spicules, as to give to the colony a rigid character. The colour of the cœnenchyma is pale rose, the majority of the spicules in its axial portion being of a rosy red colour while the outer calcareous layers are colourless. The calyces are yellowish.

*Habitat*.—Station 232, *Hyalonema*-ground, off Japan; depth, 345 fathoms; bottom, green mud.

#### 4. *Muricella perramosa*, Ridley.

*Muricella perramosa*, Ridley, Ann. and Mag. Nat. Hist., ser. 5, vol. x. p. 128, August 1882.

Ridley gives this name to a Gorgonid from Mauritius, the description and figures of which agree so closely with two pieces in the Challenger collection, that we can without hesitation place the latter in the same species, notwithstanding the wide range in their geographical distribution. The species forms a richly ramified, fan-shaped colony, the larger specimen being 35 mm. high and 25 mm. broad.

Ridley terms the primary branching dichotomous; this may be so in the sense of Dr. Gray; but there is here as little true dichotomy as in any of the Gorgonaceæ. One can distinctly distinguish a main stem, from which larger branches come off at angles of about  $45^{\circ}$ , and between them, smaller ones at from obtuse to right angles. The large branches, which may attain the thickness of the main stem, give off again, like the main stem, lateral branches and twigs. The stem and the large branches are frequently bent, and, indeed, a divergent bend always takes place at the point of departure of one of the larger branches. This gives the impression of a dichotomy.

The form of the spicules agrees with Ridley's description. The large spicules of the cœnenchyma exhibit the following proportions: 1.7 by 0.145 mm.; 1.375 by 0.16 mm.; 1.7 by 0.156 mm.; 1.5 by 0.13 mm.; 0.9 by 0.18 mm. The smaller spicules of the cœnenchyma measure 0.5 by 0.083; 0.73 by 0.16; 0.6 by 0.1; 0.75 by 0.1; 0.7 by 0.1; 0.8 by 0.1; 0.8 by 0.09 mm. The latter are, as Ridley points out, more abundant. The large spicules occasionally occur, obliquely arranged, in the angles of the branches. The calyx is composed of spicules arranged in eight groups. Each of these groups consists of two rows of spicules, converging towards the margin of the calyx, and finally projecting in eight teeth above the margin.

The tentacular operculum, which is often sunk into the mouth of the calyx, is formed of slightly curved, convergent spicules, bearing fine, sharp, little warts. They measure 0.265 by 0.025; 0.25 by 0.04; 0.2 by 0.05 mm.

There are two varieties of the species in the collection. The one is of a uniform dark carmine-red colour in spirit and of a somewhat fainter red when dry; the tentacular operculum is whitish. A second specimen, which is more graceful in all respects, has a more brick-red colour and the tentacular operculum is yellowish.

*Habitat*.—Station 232, *Hyalonema*-ground, off Japan; depth, 345 fathoms; bottom, green mud.

The British Museum specimens came from Mauritius, from a depth of 90 fathoms.

##### 5. *Muricella nitida*, Verrill (?).

*Muricella nitida*, Verrill, Amer. Journ. Sci. and Arts, vol. xlv., May 1868, p. 412.

The short description which Verrill gives (*loc. cit.*) does not enable us to determine with certainty whether the present specimen is quite identical with Verrill's species, especially since no measurements are given in the description referred to. Verrill's diagnosis runs as follows:—"The species is allied to *Muricella flexuosa*, Verr., but differs in the bright purplish-red colour and larger size of the spicula, which compose, almost exclusively, the cœnenchyma. These are relatively very large, long, fusiform, blunt at the ends, often crooked, the surface finely papillose and shining. Those of the

polyps are bright yellow. The cells are small, verruciform, and covered by small fusiform spicula, branches slender, axis light yellowish-brown, horn-like."

The colour and the condition of the spicules in our specimen agree with this diagnosis, but as more exact data are wanting the identity must remain doubtful.

The general habit of the colony quite recalls that of the preceding species. In form it is fan-shaped, ramified in one plane, divisible into a main stem and stout branches, on which the terminal twigs exhibit a pinnate arrangement. The height of the entire colony is 200 mm., and the greatest horizontal expansion is 250 mm. The main stem arises from a flat, encrusting base and ascends in an undulating manner. The bends of the stem take place in the plane of ramification and obliquely to it, and appear to be independent of the development of the branches. Numerous larger and smaller branches come off from both sides, commencing at a height of 22 mm. and following one another at intervals of 4 to 7 mm.; they stand off from the stem at angles of  $45^\circ$ ,  $55^\circ$ , to  $60^\circ$ , the latter being the angle especially in the case of the smaller branches. The large branches have almost the same thickness as the main stem and attain the same length. They give off again, like the main stem, lateral branches and smaller twigs from both sides, and this ramification may take place in the same manner up to the formation of twigs of the fifth order. The terminal twigs are short, and flattened in the plane of ramification in the same manner as the branches and secondary branches. They are blunt or somewhat thickened at the ends. Short, unbranched twigs arise from the main stem, as well as from the branches, in addition to the larger, branched ones. All the branches and twigs remain of nearly the same thickness from the base upwards.

Length of the main stem 155 mm.; thickness of the same at the base 3 mm.; thickness in the middle 3.5 mm. Length of a large branch 150 mm.; thickness of a large branch 3 mm. Length of a terminal twig 17 mm.; thickness of the same 1.5 mm.

The polyps occur on the stem, branches, and twigs, especially on one surface of the colony, while the other surface shows only the *cœnenchyma*. But even on the polyp-bearing surface the polyps are more abundantly developed on the margins, so that even here it is possible to distinguish a central region, in which the polyps are less abundant. On the terminal twigs they are placed quite laterally, usually at distances of 2 mm. Each polyp has a truncated, conical calyx, whose diameter at the base is 1 mm., while its height is 0.9 to 1 mm.

The calyces usually project at right angles from the *cœnenchyma*, but towards the ends of the branches and twigs they are directed obliquely towards the apex. The tentacular operculum, distinguished by its bright yellow colour, forms a low cone within the calyx. At the apices of the twigs there are two divergent polyps and between them a short, rounded process.

The spicules of the *cœnenchyma* form a simple layer of large, longitudinally arranged spindles, which are usually curved and often S-shaped. Frequently the

spindle narrows abruptly before its apex and then gives origin to a sharply marked off process, which is sometimes bent at an angle. Often also the point of the spicule is bent, hook-like; further, one end may be rounded off or both ends may be blunted. The spindles are thickly covered with small warts, which stand out straight and whose surfaces are again covered with minute spines. Usually these are less thickly placed than in the spicules of the preceding species. Size, 1.6 by 0.12; 1.0 by 0.25; 1.6 by 0.14; 1.6 by 0.12; 1 by 0.183; 1 by 0.125; 2 by 0.13 mm. Spicules having an average length of 1 mm. predominate, hence they may be easily seen in the cœnenchyma even with the unassisted eye.

In the calyces the spicules are spindle-shaped and rounded off at the basal end, and stand vertically or obliquely upon the cœnenchyma. They usually project from the base to the margin of the calyx, and form eight not very distinctly separated groups. They measure 0.8 to 1 by 0.125 mm. The tentacular operculum is always composed of eight series of from two to three converging spindles, lying in the base of each tentacle. Beneath these there is a well-developed colleret of bent spindles. All these are covered with short, sharp, not very thickly set spines. The spicules of the colleret measure 0.67 by 0.067; 0.75 by 0.075 mm.; those of the tentacular operculum, 0.36 by 0.05; 0.358 by 0.05 mm.

The axis is horny and flexible, in the thicker parts of a horny brown colour, in the thinner parts yellowish. The colour of the cœnenchyma and of the calyx is shining coral-red, that of the tentacular operculum yellow.

This species may be distinguished from the foregoing even on external examination. The secondary branches are usually ramified and arise at more acute angles. They also exhibit the pinnate arrangement less distinctly than in the preceding species, where they come off straight and are frequently unbranched. Moreover the difference in the thickness of the twigs and branches is slight, while in *Muricella perramosa* the secondary branches and the twigs are much more slender than the branches. The ramification in *Muricella nitida* is relatively closer; the calyces stand further apart and are more concentrated on one surface of the colony. The spicules of the cœnenchyma are on an average larger and recognisable even with the unassisted eye.

*Habitat*.—Station 232, *Hyalonema*-ground, off Japan; depth, 345 fathoms; bottom, green mud.

Verrill's specimen is from Ebon Island, in the Central Pacific, south-west of the Ralik group.

*Muricella gracilis*, n. sp. (Pl. XXV. fig. 7).

The colony forms a thin, delicate little stem, ramified in one plane and rising from a conical, encrusting base. One can distinguish an ascending main stem, from two sides of

which branches come off at right angles at moderate intervals, and these may bear again secondary branches coming off nearly at right angles. The stem and branches are slightly thickened at the ends. In the single specimen in the collection three larger branches arise on one side, of these three the second bears a secondary branch coming off from it below and the third bears two secondary branches which are directed upwards. From the other side of the stem there arises only a short unramified branch which comes off straight. The height of the main stem is 50 mm., its thickness above the base 0.5 mm. The first branch arises at a height of 18 mm. above the base. Length of the second branch 23 mm., of the third 21 mm., of a secondary branch 10 mm. The thickened ends of the branches have a diameter of 1 mm. On the stem and branches the polyps are placed mainly on the two sides in alternating rows, on the thickened ends of the branches they are arranged spirally around the whole periphery.

The calycular portion, within which the anterior part of the polyp can withdraw itself up to the tentacular operculum, forms only a low prominence, scarcely projecting above the cœnenchyma, with a diameter of 0.5 mm.

The oral region is surrounded by eight groups of upright spicules. The tentacular operculum is formed by the bases of the tentacles, on which only a few spicules occur, to the number of two or three, with converging apices, when the tentacles are folded together they do not quite fill the mouth of the calyx. The operculum scarcely projects above the margin of the calyx and is only slightly higher in the middle than at the edge.

The cœnenchyma is thick and filled with large, spindle-shaped spicules, which lie close together and are arranged mainly in a longitudinal direction on the stem and branches. They are thick and somewhat flattened, at times curved, sometimes but rarely regular, straight spindles. Frequently they are thicker towards the one end and show a tendency to become club-shaped. They are thickly covered with large, rough-surfaced, and sometimes branched warts. The warts on the outer side are always larger and generally provided with spine-like or branching outgrowths. The spicules measure 0.43 by 0.12; 0.3 by 0.12; 0.46 by 0.05 mm.

In the calyx the spicules are thickly placed around the periphery, generally, like the calyx itself, upright upon the cœnenchyma. They are now more club-shaped, curved or straight structures which are provided only with a few sharp spines; or they are structures provided with sharp, sometimes branching spines, and usually somewhat flattened. Their apices project frequently above the margin of the calyx, so that the latter appears to be surrounded by a crown of spines. The size of the spicules of the calyx is 0.2 by 0.03; 0.25 by 0.03; 0.3 by 0.033; 0.2 by 0.04 mm. In correlation to the manner in which the calyx, within which the anterior portion of the polyp can completely withdraw itself, is armed, we find the tentacular operculum only feebly developed. In the base of each tentacle there are usually two convergent, slender, curved spicules, between which a third may sometimes lie.

The axis is thin, horny, flexible and of a brown colour. The cœnenchyma and calyces are of a beautiful coral-red colour, corresponding to the intense red colour of the spicules. The tentacular opercula are whitish.

*Habitat*.—Admiralty Islands; depth, 16 to 20 fathoms.

*Muricella crassa*, n. sp.

Colony upright and ramified in one plane, with thick cœnenchyma, from which the bluntly conical polyps stand out straight, arranged in spirals. The branches and twigs are thickened at the apex.

The entire habit recalls *Paramuricea placomus* (Esper).

The main stem rises from a flat, expanded base to a height of 300 mm., with a thickness of 6 mm. which remains tolerably uniform throughout its course. Already at the base a branch, which has the same thickness as the main stem, comes off at an angle of 45°, and reaches a length of 130 mm. From this, as from the main stem, lateral branches come off on two sides, and finally bear twigs up to the third order. All are of nearly the same thickness; the terminal points are blunted and expanded (5 to 6 mm.). The branches and twigs arise at wide distances from one another; the terminal twigs attain a length of 70 mm.

The cœnenchyma is very thick and contains several layers of calcareous spicules. The horny, flexible axis is relatively thin and weak, being 1 mm. thick in twigs which have a diameter of 5 mm. The polyps project vertically from the cœnenchyma at intervals of from 1 to 1·5 mm., arranged in close, irregular spirals. The calyx forms a truncated cone, measuring 2 to 2·5 mm. at the base and 2 mm. high. The tentacular operculum can be withdrawn within the mouth of the calyx, but in the spirit specimen it forms on most of the calyces a low pyramid projecting above the calyx mouth. The apex of each twig is occupied by a short process of the cœnenchyma, on which are placed three polyps standing out in different directions.

The spicules of the cœnenchyma are large, stout spindles which are usually slightly curved. Sometimes they appear blunt at both ends, sometimes pointed at one end and rounded off at the other, but always covered with very closely placed, granular warts, which stand out straight. On the surface they form a thick layer. In the deep part of the cœnenchyma they are smaller and frequently possess one to three outgrowths, which indicate double to quadruple formations. They measure 1·2 by 0·1; 1 by 0·26; 0·9 by 0·25; 1·2 by 0·18; 0·9 by 0·125; 1·1 by 0·2; 0·62 by 0·083; 0·5 by 0·38 mm. The two last are double and quadruple spicules in which the breadth is the expansion of the lateral rays.

In the calyx the spindles form only one layer and are arranged in eight longitudinal bands, which stand vertically upon the spicules of the cœnenchyma. Each of the bands

consists of two rows of spindles converging towards the margin of the calyx, which, for the rest, have the same form and size as the spindles of the cœnenchyma. Their size averages 0·9 by 0·1 ; 0·89 by 0·067 mm. Each of the eight longitudinal bands projects spine-like somewhat above the margin of the calyx. The tentacular operculum is formed of spicules of which two always lie in the base of each tentacle, converging towards its apex. When the tentacles are folded these close together in a conical, convex operculum. These spicules measure 0·43 by 0·04 ; 0·4 by 0·05 mm. Small spicules occur also in the more distal portion of the tentacle, measuring 0·2 by 0·5 mm. and less. The spicules of the tentacles are spindle-shaped, somewhat flattened and curved, covered with small, scattered, upright, pointed warts.

The colour of the entire colony is greyish-white ; the axis is brown. The colony is densely covered with a species of *Coryne*, which forms over it quite a felted coat.

In the thickness of its cœnenchyma and in its entire habit, which recalls rather *Paramuricea*, this species differs very considerably from the other species of the genus, which are usually graceful and have a thin cœnenchyma. The shape and armature of the calyces and the structure of the spicules show, however, such a close agreement with the other species of *Muricella*, that one may without hesitation refer it to this genus.

*Habitat*.—Station 190, Arafura Sea ; depth, 49 fathoms ; bottom, green mud.

Genus *Elasmogorgia*, n. gen.

? *Filigella*, Gray, Ann. and Mag. Nat. Hist., ser. 4, vol. ii. p. 443, 1868.

This genus has been established for a small Muriceid, with a flexible, horny axis, which is covered by a thin but not transparent cœnenchyma. The polyps rise at large intervals, and at right angles to the stem. They are short and bluntly conical. The tentacles are quite retractile, and when in a state of repose the margin of the calyx is quite infolded over them.

The terminal portions of the branches are truncated and without polyps. The spicules are broad, somewhat straight, warty spindles ; sometimes curved spindles 0·2 to 0·6 mm. long ; which lie close to one another and occur both in the cœnenchyma and in the polyps. In the cœnenchyma the spicules seem to be longitudinally placed ; on the polyps they extend from the base to the oral region. The tentacles are armed with rough spiny spicules on their basal portions, which, when the tentacles are retracted, form an opercular covering, but this can be completely withdrawn into the body, so as to leave no outward trace. The only example found has a delicate flexible stem, from which one branch is given off. The stem is of the same diameter throughout, and is so flexible that it can be bent and twisted like a piece of twine. It is just possible that the form may be identical with that described by Dr. Gray as *Filigella gracilis* (*loc. cit.*) ; but the description leaves much to be desired, and in the absence of the type



specimen there can be little certainty. According to Dr. Gray's description the "Coral stem is free, filiform, simple, rather rigid," &c., but there seems no reason to suggest that the axis of the form now described was otherwise than fixed.

*Elasmogorgia filiformis*, n. sp. (Pl. XXIII. fig. 10 ; Pl. XXVII. fig. 7).

The colony consists of a long, flexible, thin, little stem, which is very slightly thickened at what is pretty certainly the terminal end; the base is wanting. Towards the upper part a simple branch is given off at an acute angle, which is not longer than the principal stem. The length of the principal stem, so far as preserved, is 270 mm., with a diameter, in the lower portion, of 1 mm., and of 1.5 mm. at its apex. The lateral branch is 30 mm. long. The cœnenchyma is thin but not transparent. The polyps arise at right angles from the somewhat flattened stem, at long intervals and for the most part from either side, in alternating series. Directly under the truncated apex of the stem, which has small polyps, three polyps stand nearly in one plane. The polyps in the lower part of the stem are somewhat cylindrical; towards the top they are more conical, with a round oral region; their basal diameter is 1 mm., with a height of 0.5 mm. The tentacular operculum in a retractile state is quite withdrawn into the calyx. The spicules are broad spindles, armed with small sharp spines, which in the cœnenchyma are placed close to one another, and are frequently curved. They constitute a thick uniform layer. In the cœnenchyma they are placed in the longitudinal direction of the stem; on the body of the polyp they are placed circumferentially, beginning from the base. They are of considerable size, so that they are discernible on a very slight enlargement. They measure, length by breadth, 0.62–0.13; 0.5–0.1; 0.33–0.08; 0.13–0.1; 0.23–0.07 mm. The basal portions of the tentacles are armed with numerous spindle-shaped spicules, which measure from 0.18 to 0.16 mm. in length, and from 0.04 to 0.016 mm. in breadth. The axis is thin, horny, black, and flexible. The colour of the stem is white.

*Habitat*.—Station 188, Arafura Sea, south of Papua; depth, 28 fathoms; bottom, green mud.

#### Genus *Muricea*, Verrill (*emend.*).

In the genus *Muricea* Lamouroux included all the then known species of Muriceids; Kölliker was the first to greatly limit it,<sup>1</sup> by separating from it the species which form the genera *Paramuricea*, *Echinogorgia*, &c., in which spindle-shaped and unilateral spiny spicules occur. Verrill<sup>2</sup> still further circumscribed the genus, and divided Kölliker's group into three, *Eumuricea*, *Muricea*, and *Muricella*. These three groups

<sup>1</sup> *Icones Histologicæ*, p. 135.

<sup>2</sup> *Trans. Connect. Acad.*, vol. i. p. 449.

seem to show sufficient differences to fairly entitle them to generic rank; *Muricea* is therefore taken here as a genus in the sense of Verrill's subgenus, which is characterised as having species "in which the verrucæ are bilabiate, or have a prolonged lower lip. The spindles of the cœnenchyma and verrucæ similar, and usually stout, but sometimes slender and pointed." To which may be added, that the tentacles in repose are quite withdrawn into the calyx; the basal portions of the tentacles, however, are armed with needle or spindle-shaped spicules, which form an octoradiate incomplete operculum, which lies over the infolded tentacular portions of the polyps. The largest number of the described species are found on the west coast of America, a few are met with in the Atlantic. The Challenger collection contains but a single species, which appears to be new.

*Muricea bicolor*, n. sp. (Pl. XXIII. fig. 11; Pl. XXV. fig. 8).

‡ *Eumicea humilis*, Milne-Edwards, Hist. Nat. des Coralliaires, vol. i. p. 149.

The stem in this species forms a short, upright axis, arising from a flat base; branches are given off in a triradiate manner; these are sometimes short, simple, terminating in knob-like masses, and are given off at right angles; sometimes rather large, and nearly of the strength of the main stem, these are furnished with smaller branches in the same manner as in the principal axis; these last have also again small lateral twigs. The larger branches arise at obtuse angles, but soon bend upwards and run parallel to the main stem. The principal stem is 80 mm. high, and 3 mm. in diameter at its base. The larger branches are from 40 to 60 mm. long, with a basal thickness of 2 mm. The terminal branches reach to a length of from 15 to 24 mm., with a thickness of 2 mm. at their base, increasing to 2.5 mm. at the extremities. The branches are about 2 mm. apart. The cœnenchyma is thick and rough on the surface. On a section being made, two layers of spicules are seen, the outer layer, 0.7 mm. thick, with rough spindles unilaterally spined, of a yellowish-white colour; the inner layer of 0.3 mm. thickness, the spicules of a violet hue. The polyps are laterally compressed, with oval mouths, whose long diameters are turned to the stem. They are so flattened to the stem that only a small portion of the outer body-wall projects free; the outer margin of the body is a little protruded, and forms a short lip. The tentacular portions of the polyps are quite retractile, the basal portion of each tentacle is furnished with needle-shaped spicules, which help to form a rudimentary covering over the tentacles. The spicules of the cœnenchyma and of the polyps are on the exterior large, one-sided spiny spindles; the spines present the form of dentate, often branched eminences, which arise in two parallel rows from the spindles, and sometimes, becoming confluent, form spiny combs. In addition to these, there are branched spines from the whole spindle. Sometimes the spindle is short, while the spiny comb-like portions are strongly developed. In other cases one end of a spindle will be expanded into a series of branched spines and

prominences. These spicules measure, length by breadth, including the spiny combs—0·58–0·16; 0·33–0·12; 0·22–0·13; 0·41–0·12; 0·3–0·12 mm. The spicules of the deeper layers are spindles, sometimes with pointed, sometimes with truncated ends; on all sides armed with branching spines; their length by breadth being 0·75–0·12; 0·41–0·12; 0·45–0·01 mm. The darker violet layer contains straight or feebly bent spindles, with simple spines, or blunt, somewhat rough spines, with a length by breadth of 0·38–0·03; 0·2–0·03 mm. The axis is of a dark brown colour, horny, and somewhat flattened and thickened at the commencement of the branches. The colour of the stem is of a light brimstone. The deeper layer of the cœnenchyma is of a violet hue. The habit of the species and the form of the polyps agree very closely with *Eunicea humilis*, Milne-Edwards,<sup>1</sup> so that, being found in the same locality, the identity of the two is not improbable. While from the shape of the polyps and its habit the species might be placed among the *Eunicea*; yet the shape of the superficial layer of spindles, and the absence of the outer club-shaped layer, characteristic of *Eunicea*, makes it more expedient to place it among the *Muricea*; where however it may be regarded as somewhat intermediate between the two genera.

*Habitat*.—Off Bahia; depth, 10 to 20 fathoms.

#### Family V. PLEXAURIDÆ, Gray.

*Plexauridæ*, Gray, Ann. and Mag. Nat. Hist., ser. 3, vol. iv. p. 442, 1859.

*Euniceidæ*, Kölliker, Icones Histiol., Abth. ii. p. 137, 1865.

*Plexauridæ*, Verrill, Trans. Connect. Acad., vol. i. p. 413, 1869.

Professor H. Milne-Edwards (1857) arranged the genera *Plexaura* and *Eunicea* in a division of his second group of the Gorgonaceæ with the genera *Gorgonia* and *Leptogorgia*; following in close sequence of time Dr. Gray (*loc. cit.*) made the family Plexauridæ to include the two genera *Plexaura* and *Eunicea*, indicating also two new genera.

This family he characterised as follows:—"Bark granular, persistent, cork-like, without any impressed grooves. Cells placed equally on all sides of the branches."

Kölliker (*loc. cit.*) adopted the genus *Eunicea* as the type genus, and diagnosed the family Euniceidæ as "having a thick cœnenchyma, not superficially echinulate, but provided with a cortical layer of club-shaped spicules; verrucæ absent or well developed. Axis calcareous (*Plexaurella*) or horny."

Kölliker included in this family *Eunicea*, Lamk., *Plexaura*, Lamx., *pro parte*, and a new genus *Plexaurella*, for *Gorgonia dichotoma*, Esper, and allied forms, in which the stem structure and spicules were of a different type from those in *Plexaura* as now defined.

<sup>1</sup> Hist. Nat. des Coralliaires, vol. i. p. 149, pl. B<sup>2</sup>, fig. 1.

Verrill<sup>1</sup> added the genus *Euplexaura* for forms of which *Euplexaura capensis* may be taken as a type, and in which the form of the spicules differs widely from those met with in the other genera; the same author in his Notes on Radiata (*loc. cit.*) describes the family as having a "Corallum usually dichotomous and more or less arborescent. Axis horn-like, or more or less calcareous, especially at base. Longitudinal ducts equal, arranged regularly all round the axis. Cœnenchyma usually thick. Cells scattered over all parts of the surface, flat, or elevated on prominent verrucæ. Tentacles at base and sides of the polyps stiffened with large fusiform spicula. Spicula of the cœnenchyma usually large, of various forms, most frequently there are large warty spindles mingled with clubs or crosses."

Verrill makes a new genus *Psammogorgia*, for *Gorgonia fucosa*, Val., &c., and further, in his Critical Remarks on Polyps<sup>2</sup> he establishes another new genus *Eunicella*, for *Gorgonia verrucosa*, P., and many allied forms.

The genera belonging to the family as it now stands certainly require revision, but to do this effectually it would be necessary to re-examine not only a very large number of described species, but to investigate them in a well-preserved state, as there are not wanting indications that differences exist in the minute structure of the axis and of the polyps, in addition to the manifold differences in the form of the spicules; the species found during the voyage of the Challenger were but few in number, and it would be premature to revise the group on the materials at our disposal. We therefore accept the family as containing among others the following genera:—*Eunicea*, Lamk., *Plexaura*, Lamx., *Psammogorgia*, Verrill, *Plexaurella*, Köll., *Eunicella*, Verrill, and *Euplexaura*, Verrill, this last genus being very nearly related to the Gorgonidæ. Klunzinger would refer the genus *Plexaurella* to the Gorgonellidæ, on account of the structure of the axis, but the axis in this latter family would appear to differ somewhat in the arrangement of the longitudinal canals.

Two new genera we have felt obliged to make for already known species, *Plexauroides* and *Pseudoplexaura*, and, from an examination of numerous species in the Museums of Paris and Turin, we think it very probable that still further divisions of the genera *Eunicea* and *Plexaura* will have to be made.

Species of the following genera have been found during the cruise of the Challenger:—

*Plexaura*, Lamx.  
*Plexauroides*, n. gen.  
*Plexaurella*, Kölliker.

*Pseudoplexaura*, n. gen.  
*Euplexaura*, Verrill.  
*Eunicella*, Verrill.

<sup>1</sup> *Proc. Essex Inst.*, vol. vi. p. 74, August 1869.

<sup>2</sup> *Amer. Journ. Sci. and Arts*, November 1869, p. 426.

Genus *Plexaura*, Lamouroux, *emend.**Plexaura*, Lamouroux, Hist. des Polypiers flexibles, p. 24, 1816.

,, Milne-Edwards, Hist. Nat. des Coralliaires, vol. i. p. 152, 1857.

,, Kölliker, *pro parte*, Icon. Histiol., Abth. ii. Heft 1, p. 138, 1865.*Plexaura valenciennesi*, n. sp. (Pl. XXXIII. fig. 1).*Plexaura flexuosa*, Lamk., Valenciennes ("de la Havane"), Comptes rendus, t. 41, p. 12, 1855.

Non ,, ,, Lamouroux, Hist. des Polypiers flexibles, p. 424, 1816.

The species of this genus would appear to be essentially shallow-water forms. Only a single species appears in the Challenger collection; this was dredged in one of the Bays of the Bermudas, in quite shallow water. It appears to be as yet undescribed, although it is the form referred to by Valenciennes which is in the Museum at Paris.

In the only specimen preserved the colony arises from an attached and somewhat spreading base to a height of 24 cm., the main axis being at its base 12 mm. in diameter; when about 12 mm. high it branches. The larger of the two branches is 8 mm. in diameter and attains a height of 20 cm.; from it several other branches proceed, but from the one side only and in the same plane, and from these secondary twigs proceed in like manner.

The diameter of the principal twigs is from 3 to 5 mm. The basal portion of the axis is denuded of polyps, and here the outer layer of purple spicules being worn off, the middle layer of large spicules is seen to form a compact pavement.

The colour of this portion of the axis is a dirty brown; that of the upper portion and of the branches is a dark purple with a slight tinge of yellow.

The polyps are numerous, thickly set in irregular spirals round the stem and branches, extending to the very summits of these latter. The position of each polyp is very distinctly marked by a short papilliform projection which is often circular but sometimes oval, and within which the polyp is completely retractile, the tentacles being drawn in last, when the central pit slightly contracts, and in doing so a bilabial appearance is sometimes seen. These projections rise but slightly from the level of the cœnenchyma, but sufficiently so to give a quite pustulate appearance to the colony.

The cœnenchyma is massive, and formed of several layers of spicules; the outer layer consists of purple-coloured spicules, foliated clubs, and spindles, beneath which is a layer of large, tuberculate, fusiform spicules, while the innermost layer is formed of small, radiate, tripartite and fusiform spicules of a bright purple colour or colourless.

The small nutrient canals from each polyp penetrate beneath the first layer in communicating with those of the neighbouring polyps, while a series of larger nutrient canals runs parallel with the axis within cover of the middle layer of spicules. The central axis is horny.

The polyp bodies, at least the retractile portions, are destitute of spicules, unless for

a double row of minute, spiny, fusiform spicules, which are to be found in the outer walls of each of the tentacles, which, when the tentacles are withdrawn, form a protection to the soft parts of the polyp.

*Measurements of the Spicules.*—The large spindles 1–0·3; 1·6–0·5 mm. The smaller spindles 0·6–0·2; 0·5–0·1; 0·42–0·1; 0·4–0·14; 0·3–0·08 mm. The clubs vary from 0·3 to 0·2 mm. in length. Those with broad folia measure in the broadest diameter 0·15 mm., those with narrow folia 0·08 mm. The four-rayed spicules measure 0·1–0·1 mm. The needle-shaped spicules at the base of the tentacles measure 0·2–0·02; 0·06–0·02 mm.

*Habitat.*—Bermuda; shallow water.

### Genus *Plexauroides*, n. gen.

Colony branching, mostly in the one plane. Stem and branches cylindrical. Axis horny, dense, with the central portion calcareous. Nutrient canals symmetrically arranged. Cœnenchyma thin, consisting of two very distinct layers of spicules, the one nearest the axis is composed of irregular stellate forms, the outer layer of large Blattkeule, the broad foliar expansions of which project beyond the surface of the cœnenchyma, forming a rough imbricated surface.

The polyps are numerous, fully retractile, with scarcely visible verrucæ, the edges of these latter being fringed with rows of the broad projecting folia of the Blattkeule.

This genus is established for the forms of *Plexaura* with large Blattkeule, which project by their thin-edged folia beyond the surface of the cœnenchyma, and present the appearance of a series of imbricated scales.

On a revision of all the genera of the Plexauridæ it is probable that several species of *Plexaurella* may have to be relegated to this genus.

*Plexauroides prælonga* (Ridley) (Pl. XXVIII. figs. 1, 1a; Pl. XXXIII. fig. 2).

*Plexaura prælonga*, Ridley, Rep. Zool. Coll. H.M.S. "Alert," p. 339, 1884, pl. xxxvi. fig. F, pl. xxxvii. figs. g. g'.

Two specimens, which may be referred to the above species, are in the collection from Torres Strait.

The colony is erect, branching in one plane, forming an irregular dichotomy. In one of the specimens (that figured) the colony is attached by a flat, irregular disc, measuring 15 by 10 mm. The main axis, at about a height of 20 mm., gives off a branch 30 cm. long; then at an interval of 10 mm. a second branch nearly as long as the first; at a distance of another 10 mm. a third branch arises, but from the opposite side of the axis, this one reaches a length of 20 cm., while the main stem continues unbranched for a further length of 26 cm.

The main axis is 4 mm. in diameter at its base, narrowing to 2.5 mm. at its termination. The diameter of the branches at their origin is 3 mm., and they taper gradually to a diameter of 2 mm. at their tips. In the second specimen, which has been torn from its attachment, the third and fourth branches give off also smaller twigs, and in the case of the third branch the first twig given off again ramifies. The whole colony is larger than in the other specimen, the basal diameter of the main axis being 5 mm., and its length is at least 34 cm. The origin of the branches at the main stem is in several instances enlarged. The axis and branches are cylindrical.

The verrucæ are numerous, and closely but irregularly packed on the stem and branches, they are very slightly elevated; the polyps are completely retractile within them. In the larger specimen the verrucæ are more distinctly elevated. The distance from centre to centre of the verrucæ is from 0.5 to 1 mm. The foliar expansions of the peculiar club-shaped spicules stand out, forming a margin to the verrucæ.

The polyps are completely retractile, the tentacles being first withdrawn slightly inwards and then the whole polyp body is retracted; the walls of the verrucæ are also capable of contraction; the bodies of the polyps are destitute of spicules, but there is a well-developed collar of needle-shaped spicules around the base of the tentacles, and two curved, needle-shaped spicules run from this along the outer basal portion of each tentacle; between which there is generally a third.

The cœnenchyma is comparatively thin and somewhat friable, its outer portion is rough, and consists of the large, club-shaped spicules, and beneath these are simple or branched, spiny spindles and tri- and quadriradiate spiny forms.

The spicules are as follows:—The foliaceous clubs have a short, thick neck, from which project downwards one, two, or three spiny arms, often these are much branched; the foliaceous portions are very irregular in outline, thicker where they rise from the neck portion, they soon narrow to an edge, which varies from a semioval to a triangular form. The edges are sometimes smooth, sometimes jagged; on the constricted portion tubercles occur in the older forms. They measure 0.6–0.3; 0.6–0.4; 0.4–0.56; 0.36–0.4; 0.26–0.22 mm. The spiny spindles are sometimes simple, at other times branched. They measure 0.6–0.1; 0.3–0.1; 0.2–0.06; 0.18–0.04 mm. The branching spiny spindles gradually merge into irregular tri- and sexradiate forms, measuring across the arms 0.46–0.26; 0.36–0.2; 0.3–0.2; 0.2–0.2 mm. In the tentacles or at their base the curved spicules measure from tip to tip 0.2 mm., with a diameter to each arm of 0.04 mm. The straight spicules measure 0.3–0.04; 0.2–0.04 mm.

The general colour of the colony is a deep brownish-red; the polyps being of a pale yellow. The axis is tough, flexible, of a dark black colour. The species had been selected for figuring (1883) as new, but seems to be merely a variety of *Plexauroides prælonga* (Ridley).

*Habitat*.—Station 186, Cape York; depth, 8 fathoms; bottom, coral sand.

Genus *Plexaurella*, K  lliker.*Plexaurella*, K  lliker, Icones Histiol., Abth. i. p. 138.

K  lliker established this genus for a number of forms previously placed with *Plexaura*, but in which the structure of the axis differed from that of *Plexaura* in being composed of irregularly deposited layers of horny and calcareous substance. Valenciennes had long since indicated this genus but had given no diagnosis thereof. As K  lliker observes, the genus agrees, with the exception of the structure of the axis, in most particulars with *Plexaura*; it may be observed that in the only species found in the Challenger collection, the affinities to *Plexauroides*, so far as the shape of the spicules is concerned, is very marked, but the stem structure is exactly as described by K  lliker in *Plexaurella*; this stem structure is also to be met with in some species of *Juncella*, viz., *Juncella juncea*, but here the very different characters of the spicules will always serve as a good generic difference.

*Plexaurella phillipinensis*, n. sp. (Pl. XXXIII. fig. 4).

The only specimen in the collection has been torn from its attachment, and may be the entire colony with the exception of its basal portion; or possibly it may be but a portion of a very much larger mass; the lower parts of the stem and branches are somewhat rubbed and worn.

The colony is a much branched one; the branches arising approximately in the one plane. The portion of the colony preserved forms a fan-shaped mass, about 35 cm. in height, by 50 cm. broad. The diameter of the apparently main stem is 3 mm., that of the larger branches 2 mm., the terminal portions of the smaller ramifications measure from 1 to 1.5 mm. The principal branches arise in an alternate manner, and these give off again and again smaller branches, the ultimate twigs being from 5 to 10 mm. long. There are no traces of any anastomosing of the branches. The basal portions of the stem and branches are flattened, but towards the terminations of the twigs this is less noted. The polyps are completely retractile, and when in a state of repose, sink within cover of the c  nenchyma of the axis; they are scattered irregularly over the whole of the colony, and are about 1 mm. apart; the very small spicules of the bases of the tentacles form in the retracted state of the body a protective operculum.

The c  nenchyma is thin and friable. The foliaceous portions of the club-shaped spicules are short and lobose, giving a roughened granulose appearance to the surface, which is well seen with a low magnifying power.

The main axis is flattened and consists of irregularly concentric layers of calcareous and horny substance, which seem to be more developed on the one half of the axis than on the other. In the smaller branches the axis seems to be entirely horny and flat;



with a broadened web-like expansion at the origin of each of the twigs. The nutrient canals as in *Plexaura*.

The spicules of the cœnenchyma are as follows:—First the foliaceous clubs, which measure 0·3–0·26; 0·2–0·18; 0·2–0·1; 0·18–0·2 mm. The foliaceous portions are broad and short with a wavy outline, the root-like processes are spreading and very spiny. The spiny spindles are small, 0·3–0·04; 0·24–0·04; 0·12–0·04 mm. The tri- and quadriradiate forms are few and have not the characteristic form generally to be found in the species of this genus, they measure 0·2–0·1; 0·12–0·1 mm. The curved and straight needle-shaped spicules found in the tentacles are 0·2–0·02; 0·1–0·02 mm.

While in the structure of the axis this species must be referred to *Plexaurella*, yet it would seem to differ in several respects from all the hitherto described forms; and the spicules seem intermediate between those of *Plexaura* and *Plexaurella*. It must however be conceded that there is a great deal of uncertainty as to the species which should be placed under these genera, and a careful examination of all the types of Esper, Milne-Edwards, and Verrill will be needed ere this question can be properly settled.

Klunzinger<sup>1</sup> suggests that *Plexaurella* should be placed near to *Juncella*, which no doubt in the structure of its axis it somewhat resembles, but pending a thorough revision of the group it seems more advisable to leave it in the family Plexauridæ.

*Habitat*.—Station 208, January 17, 1875, Philippine Islands; depth, 18 fathoms.

#### Genus *Pseudoplexaura*, n. gen.

Professor Kölliker emended the diagnosis of the genus *Plexaura*, having separated first therefrom the species forming the new genus *Plexaurella*, by forming two sections, called by him “duræ” and “molles,” which differed in the nature of the cœnenchyma, in the former large spindle-like spicules being found, while in the latter the cœnenchyma is soft, thick, and friable without the large spicules. In both the outer layer is composed of club-shaped or spiny spicules of various shapes. In the present genus the axis is horny, with a central calcareous portion, the outer layer of cœnenchyma is soft and when dry friable; the inner layer contains a number of light purple or violet coloured irregularly stellate spicules or spindles with few rays. The following diagnosis will help to distinguish it from *Plexaura*.

The colony is but feebly branched; the axis horny, in the older portions solid; in the younger and terminal portions the centre is partially filled with calcareous particles. The cœnenchyma is thick and membranous, the outer layer is white, friable; in older portions the outer layer of spicules gets rubbed off, leaving a soft membrane in which the polyps are embedded, but in the younger portions there is a well-marked layer of colourless spindle-shaped spicules. The polyps are placed close to one another in a somewhat regular spiral

<sup>1</sup> Die Korallthiere des rothen Meeres, Th. i. p. 59.

manner. The polyps are completely retractile, there is no circle of spicules at the base of the tentacles, and there are no spicules in the tentacles. When the polyps are withdrawn, the tentacles invaginate, their bases forming a central knob-like mass, the upper walls of the mesenterial chambers, which when the tentacles are infolded become inflated, forming an eight-rayed frill, next sink in, forming a series of eight depressions which extend from the bases of the tentacles to the external body-wall of the polyp. The spicules are for the most part spiny spindles, with numerous pink stellate forms and a few club-shaped forms with attenuated foliaceous expansions.

*Pseudoplexaura crassa* (Ellis and Solander) (Pl. XXXIII. fig. 3).

*Gorgonia crassa*, Ellis and Solander, The Natural History of many curious and uncommon Zoophytes, &c., p. 91, 1786.

It is with a great deal of doubt that a series of large fragments, dredged in shallow water at the Bermudas, is referred to this species. The original description is as follows:—"Gorgonia teres dichotoma, ramis crassis virgatis divaricatis ascendentibus, carne violacea crassa, osculis prominulis æqui distantibus, polypos octotentaculatos marginibus cirratis exserentibus, osse subfusco corneo," and "this Fleishy Gorgon is round and dichotomus with long fleshy branches, which bend a little out and then grow upright. The flesh is of a violet colour, plump and full of little rising mouths, disposed on the surface near one another and at equal distances, these send forth polypes with eight claws, these have small fibres on each side. The bone is of a dark brown colour like horn." The specimen described was preserved in spirits, and the remark is added that "the flesh is very thick and the bone very small at the extremities; in large old specimens the bone is very black and like horn." We are thus particular, as Verrill<sup>1</sup> records a species from the same locality under this name which he thinks agrees perfectly with the description of Ellis. In his remarks on this agreement Verrill quotes Ellis as describing the arrangement of the cells as "scattered," whereas it will be seen from the above quotation that Ellis describes them as "disposed near one another and at equal distances."

Verrill gives *Gorgonia porosa*, Esper, *Gorgonia antipathes*, Esper, and *Gorgonia vermiculata*, Lamk., as synonyms of this species, but an examination of these species shows marked differences between each of them, and that they are not even very closely related to this form; *Plexaura porosa* (Esper) has a well-marked layer of foliaceous and one-sided spiny clubs. *Plexaura antipathes* (Esper) is easily distinguished by its spiny spheres and branching spiny spindles, while *Gorgonia vermiculata*, Lamk., is a *Plexaurella*.

The colony is feebly branched, mostly in one plane. The height of the various fragments collected, apparently torn from the one base, varies from 150 to 225 mm., with a basal diameter of 8, 10, and 12 mm. respectively, which tapers to one of 4 mm. at the

<sup>1</sup> Bull. Mus. Comp. Zool., 1865, vol. i. p. 34.

slightly knobbed terminations. Branches arising very sparingly from the presumably main stems. Axis horny, with a calcareous centre and calcareous particles interspersed. Polyps crowded in a somewhat spiral manner on the stems and branches; projecting very slightly from the level of the cœnenchyma, but sufficiently so to give a papilliform appearance to the colony. The polyps and tentacles are retractile; the upper walls of the eight mesenterial chambers, when the polyps expand, become inflated and form a circlet of little flaps around the base of the tentacles, these inflations are somewhat pouch-shaped and resemble an outer circlet of simple frill-like tentacles; on the tentacles becoming withdrawn, these inflations are infolded and in the dried specimen become depressed, so as to give the appearance of eight depressions around the central portion of the polyps (the chambers seem to communicate by pores with the exterior). The polyps are 1.5 mm. in their broadest diameter. The cœnenchyma is thick and tough (friable when dried), the outer layer is white and semimembranous, with but few spicules and these colourless; the inner layer is packed with purple or violet coloured spicules; this dense layer sometimes shows through the outer layer. The numerous nutrient canals surround the axis.

There are no spicules in the tentacles nor at their bases. Those in the outer layer of the cœnenchyma are colourless spiny spindles, and a few club-shaped forms; in the inner layer the coloured spicules are either crosses or few-rayed spindles; the following are the measurements. Colourless spiny spindles—0.52–0.1; 0.56–0.1; 0.30–0.04; 0.82–0.12 mm.; club-shaped forms 0.3–0.1; 0.32–0.18; 0.4–0.16 mm.; pink spindles 0.2–0.12; 0.34–0.14; 0.32–0.12; 0.18–0.1; 0.16–0.1; 0.14–0.1; 0.12–0.05 mm.; pink crosses 0.12–0.08; 0.16–0.1; 0.24–0.1 mm.

*Habitat*.—Bermuda; shallow water.

### Genus *Euplexaura*, Verrill.

*Euplexaura*, Verrill, Proc. Essex Inst., vol. vi. p. 74, 1869.

Verrill<sup>1</sup> in 1865 referred a species from the Cape of Good Hope to the genus *Plexaura* as *Plexaura friabilis*, Lamk. Although it possibly might have been in part known to Lamouroux, it is certainly not the *Plexaura friabilis* of Milne-Edwards and other modern writers, because this latter proves to be a *Plexaurella*. For this form Verrill afterwards made (*loc. cit.*) the genus *Euplexaura*, naming the species *Euplexaura capensis*.

The spicules differ widely from those of *Plexaura*, and although in some respects they approach those of *Plexaurella*, yet they would seem to differ as widely from these as they do from *Plexaura*. "In external characters it resembles *Plexaurella*, with rather large, open cells. The spicula are mostly short, stout, blunt, warty spindles, of

<sup>1</sup> *Bull. Mus. Comp. Zool.*, vol. iv. p. 186.

rather small size, with a few small, simple double-spindles, and rarely small, irregular crosses." To this may be added that in the structure of the axis there is a general resemblance to that of *Plexaurella*. The following two species come from Japan.

*Euplexaura pinnata*, n. sp. (Pl. XXXIII. fig. 5).

The colony arises from a broad, irregular, membranous base, which spreads over the surfaces of rocks, stones, &c. In well-developed specimens, the main axis reaches a height of 3 dm.; being slightly flattened at its base, where it measures from 5 to 6 mm. in diameter. Two branches are given off at a height of 5 mm., and these give origin to a second and third series of branches, which are all given off in the one plane; the primary branches reach a length of 2.5 dm., other lateral branches are given off at intervals of from 6 to 10 mm. and are about 3 mm. in diameter, tapering from this to 2 and 1 mm., so that the whole colony assumes a broad, flattened, fan-shaped form.

On cross section the axis is seen to consist of a central hollow or somewhat calcareous portion, 5 mm. in diameter, which is surrounded by a horny layer, 1 mm. in thickness; this is infiltrated with calcareous particles, which want, however, the symmetrical arrangement which is seen in *Plexaurella*. In the outer layer the nutrient canals run.

The polyps are scattered in irregular spirals over both the axis and the branches; they are completely retractile within the thickness of the cœnenchyma. When the polyps are quite withdrawn, the walls of the cœnenchyma close in over them so that there is but little trace of the polyp cavities, but when these cavities are left partially open, they are somewhat oval in form.

The cœnenchyma is dense and granular. The spicules of the polyps are small flattened needles, toothed on their edges, mixed with some quadriradiate forms; the spicules in the tentacles are minute curved needles, those of the cœnenchyma are small warty spindles with a few tri- and quadri-radiate forms.

The spicules measure 0.06–0.02; 0.1–0.04; 0.2–0.04; 0.12–0.04; 0.16–0.04; 0.1–0.04; 0.1–0.08; 0.1–0.02; 0.08–0.06 mm.

The colour in spirits is a light brown.

It is possible that this may be the *Plexaura olivacea*, Lamx.,<sup>1</sup> described as "*Plexaura ramosissima*; ramis sparsis vel subpinnatis; cortice olivacea; cellulis sparsis distantibus. Indes orientales."

*Habitat*.—Stations 233 and 233A, Kobé, Japan, May 17, 19, 1875; depths, 8 and 50 fathoms.

*Euplexaura parviclados*, n. sp. (Pl. XXXIII. fig. 6).

In this species the colony arises by a much-divided base which spreads over and clings to small shells and pebbles.

<sup>1</sup> Hist. des Polyp. flexibles, p. 431, pl. xvi. (Hist. Nat. des Coralliaires, vol. i. p. 156).

The main axis is about 2 dm. in height, but in the only specimen found it is evidently broken off, and is decorticated towards the summit. It is 5 mm. in diameter at its base, and gives off three branches, the lower at about 8 cm. from the base, this spreads out laterally to a length of 2.5 dm., giving origin to a second branch about 15 cm. long. The two other branches are given off at intervals of 15 mm. above the first; the central one is 9 cm. long; the upper one is the longest and thickest of the three, probably owing to the damage done to the main axis just above its origin, it is also in parts flattened.

The intimate structure of the axis is as in the previous species.

The cœnenchyma is dense and granular.

The polyps are numerous and somewhat irregularly disposed on the main axis and the branches. The polyps, when contracting, first withdraw their tentacles, and then the whole body of the polyp sinks within the cœnenchyma. After the withdrawal of the polyp, the walls in contact with the cœnenchyma are drawn together, and the latter get drawn over the polyp, leaving but a mere chink to indicate the polyp-cavity.

The spicules are spindles, with two or four rows of foliated warts, or quadriradiate forms; the spicules in the polyps are slightly curved, needle-shaped forms.

The spicules measure 0.2–0.08; 0.26–0.02; 0.2–0.06; 0.18–0.16 mm.

*Habitat.*—Stations 233 and 233A, Kobé, Japan, May 17, 19, 1875; depths, 8 and 50 fathoms.

### Genus *Eunicella*, Verrill.

*Eunicella*, Verrill, Amer. Journ. Sci. and Arts, vol. xlviii. p. 425, 1869.

Verrill established this genus, taking *Gorgonia verrucosa*, Pall., as the type, for those species included by Kölliker in his third section of the genus *Gorgonia*. Afterwards Verrill<sup>1</sup> referred this genus to the Plexauridæ, placing it near *Eunicea*, with which group Ehrenberg indeed had united it. Verrill's diagnosis is as follows:—"Cœnenchyma thin or moderately thick, composed chiefly of small warty double spindles, but having a distinct external layer of very small, peculiar club-shaped spicula perpendicular to the surface, which often have one or two whorls of fine spinules towards the larger end. Cells scattered, either raised on prominent verrucæ or perfectly flat. Longitudinal ducts nearly equal, in a circle around the axis. The colour usually white."

#### *Eunicella papillosa* (Esper), Verrill.

*Eunicella papillosa*, Esper, Fortsetzung., p. 173, Tab. L.

A small branch belonging to a colony of this common species was found in a dredging taken in Simon's Bay.

While the spicules of this genus somewhat recall those of *Juncella*, yet the axis is horny, and quite unlike the solid calcareous axis of the Gorgonellidæ.

<sup>1</sup> Notes on Radiata, No. 6, *Trans. Connect. Acad.*, vol. iii. p. 386, footnote.

## Family VI. GORGONIDÆ, Verrill.

*Gorgonidæ*, Dana, *pro parte*, Zoophytes, p. 651.

*Gorgoniaceæ*, Milne-Edwards, *pro parte*, Hist. Nat. des Coralliaires, t. i. p. 144.

*Gorgoniaceæ*, Kölliker, *pro parte*, Icones Histiol., p. 139.

*Gorgonidæ*, Verrill, Trans. Connect. Acad., vol. i. p. 386 and footnote (reprint), 1869.

The group *Gorgoniaceæ* of Milne-Edwards included those *Alcyonaria* which possessed a solid axis, consisting of corneine and but very slightly effervescing on the application of a strong acid; in this differing from the forms of *Gorgonellidæ*; while they differed from the *Primnoids* and *Muriceids* in the nature of their spicules.

Kölliker separated the group into two divisions—the *Euniceidæ* and the *Gorgoniaceæ*.

Verrill, though as far as we know not characterising the group, has accepted Kölliker's division as equivalent to a family, in which sense it is taken here. He has well defined many of the genera belonging thereto.

Species of the following genera are to be found in the Challenger collection :—

*Platycaulos*, n. gen.

*Callistephanus*, n. gen.

*Lophogorgia*, Milne-Edwards.

*Leptogorgia*, Verrill.

*Gorgonia*, Auct.

Genus *Platycaulos*, n. gen.

Colony branched, the branches in one plane, anastomosing. The axis is horny, flattened; with a calcareous centre and calcareous particles interspersed amid the horny layer; the nutrient canals surrounding the central axis almost as in *Plexaura*. Polyps prominent, on the sides of the stem and branches; retractile within verrucæ. Cœnenchyma moderate, like shagreen. Spicules, straight and curved spiny spindles and stellate forms.

In their *Memoire sur les Coralliaires des Antilles*, Duchassaing and Michelotti established a new genus *Thesea* for the *Gorgonia exserta* of Ellis and Solander, placing this genus as “intermédiaire entre les genres *Muricea* and *Primnoa*.” Afterwards in the Supplement to their work they state that they had confounded this species with another for which they had intended the genus *Thesea* (*Thesea guadalupensis*), and they make the genus *Swiftia* for the *Gorgonia exserta*, E. and S. Both these genera are placed in their division of the *Primnoaceæ* with scale-like spicules in the cœnenchyma.

The type specimens of *Swiftia exserta*, D. and M., not being at Turin it is not easy to say what form these authors referred to. The original description of Ellis and Solander<sup>1</sup> is as follows :—“*Gorgonia teres* sparse ramosa, ramulis alternis, osculis octovalvulis alternis, polypis octotentaculatis exsertis, carne squamulis albis vestita, osse subfuscocorneo.” The specimen described was two feet in height, very loosely branched, with long slender

<sup>1</sup> Nat. Hist. of Zoophytes, p. 84.

white branches. The enlarged figure of a polyp represents a thin central horny axis with a rather thick cœnenchyma and a semi-retracted polyp, possibly a Muriceid.

The enlarged figure given of *Swiftia exserta*, D. and M. (*loc. cit.*, pl. xi. fig. 5), shows a thin cœnenchyma with a thick axis, and we read "Nous ne donnons pas la description de cette espèce, qui a déjà été publiée par les auteurs." Good specimens of *Thesea guadalupensis*, D. and M., are still in the Museum at Turin, and this form would appear to be near *Acis*, D. and M. The axis is horny, not effervescing with acids; polyps prominent, and the cœnenchyma is loaded with very large irregular spicules.

A new species of *Thesea* has been described by Verrill,<sup>1</sup> *Thesea gemmata*, which the author says resembles in external characters *Gorgonia exserta* as figured by Ellis and Solander, which latter Duchassaing and Michelotti refer to their *Swiftia exserta*, but it has more prominent verrucæ. Its spicules are however very different from those of *Thesea guadalupensis*, D. and M. The *Gorgonia richardii*, D. and M., bears some resemblance to it in external appearance, so far as one can judge from the figures, but has stouter branches and more cylindrical verrucæ.

It seems desirable to mention these facts here, for *Thesea gemmata*, Verrill, appears to have a likeness to a very interesting species of Gorgonid found by the Challenger Expedition at Banda, for which we have been obliged to make the above new genus, Verrill's species was obtained in deep water off St. Croix, West Indies.

*Platycaulos danielsseni*, n. sp. (Pl. XXXIII. fig. 8; Pl. XXXV. figs. 1, 1a).

The colony is branched, the branches arising in the one plane; both the stem and branches are compressed. The total height of the colony is 325 mm., with a basal axial diameter of 8 mm. in its broad and of 4 mm. in its short diameter. The colony was attached by a broad base, the remains of which are preserved. The branches rise at intervals of about 10 mm., at a height of 95 mm. from the base the broad diameter of the axis is 6 mm. The first six branches from the left side of the stem are short, from 15 to 20 mm. in length, simple or feebly branched. The seventh extends to a length of 170 mm. with a breadth of 5 mm., and divides into a number of smaller branches which again divide; between two of these there is an anastomosis. At an interval of 50 mm. another large branch is given off, which also divides as in the former case; between the two large branches and between the second branch and the apex of the stem there are several small twigs; the lengths of these diminish as they approach the summit. The ramification of the left side of the stem is of the same nature, but all the branches are smaller than those of the opposite side, not exceeding 130 mm. in length. One of the smaller branches has become anastomosed with the main axis. The cœnenchyma is moderate in thickness, when dry it presents a roughened appearance owing to an outer layer of spiny spindle-shaped spicules; an inner layer contains both stellate and spindle-shaped spicules.

<sup>1</sup> *Amer. Journ. Sci. and Arts*, vol. xlviii. p. 428.

The polyps are situated in rows on both sides of the stem and its branches, leaving the whole central portion of these, both front and back, quite free from polyps. Both polyps and tentacles are retractile, the former are lodged within well-marked verrucæ; the tentacles are first infolded and then completely withdrawn. The verrucæ seem to be more prominent towards the summit of the branches, but in some instances it seems evident that when the polyps are completely retracted, the walls of the verrucæ can contract over them, so as to leave the verrucæ not very prominent; the verrucæ measure at their base about 1.5 to 3 mm. in diameter. The apices of the stem and branches do not end in polyps. New polyps arise alongside of and between the old polyps. The nutrient canals surround the horny axis as in *Plexaura*.

The axis is flattened, horny, with a central calcareous core; it is very flexible and tough. In certain portions, on section, calcareous deposits are seen, but these have not the symmetry of those to be met with in *Plexaurella*.

There is a circle of curved spiny spindles around the base of the tentacles, and smaller spindles, but straight, clothe the dorsal surface of each tentacle; very minute needle-like spicules are found in the tentacles. The spicules measure, the large spindles with rough spines, 0.6–0.1; 0.5–0.1; 0.4–0.1; 0.3–0.08; those with few spines, 0.2–0.02; 0.1–0.08; 0.1–0.02; 0.08–0.02; and the stellate spicules measure 0.2–0.1; 0.14–0.2; 0.12–0.12; 0.1–0.08; 0.1–0.06. Most of the spicules are of an amber colour.

The colour in spirits is that of a dark brick-red.

*Habitat*.—Banda, in 14 fathoms.

#### Genus *Callistephanus*, n. gen.

Axis horny, circular, with a calcareous central portion, and in the older portions calcareous particles interspersed; branched, branches arising in the one plane, mostly at right angles to the stem or to one another. Nutrient canals surround the central axis.

Polyps very prominent, the tentacles and bodies retractile within dome-shaped verrucæ, and arising for the most part alternately from the sides of the stem and branches.

The cœnenchyma is thick, granular. The spicules of the cœnenchyma are spiny spindles, clubs, and half-sided warty clubs; those of the base of the polyps are needle-shaped.

Verrill<sup>1</sup> describes a new genus of Gorgonid for a small delicate coral, pure white in spirits, with rather prominent calyces in two alternating rows. This species, *Stenogorgia casta*, externally resembles *Thesea* and *Eunicella*, but in the former the cœnenchyma has a superficial layer of scales, and in the latter it has a regular external covering of club-shaped spicules standing perpendicularly to the axis. In *Swiftia*, which

<sup>1</sup> *Bull. Mus. Comp. Zool.*, vol. xi. p. 29.



has a similar appearance, the cœnenchyma is said to consist of small scales only. Its affinities are apparently with *Leptogorgia*. This species was found at a depth of 337 fathoms in lat.  $31^{\circ} 48' 50''$  N., long.  $77^{\circ} 51' 50''$  W. There is a remarkable resemblance, so far as external form goes, between this species of Verrill's and the one for which we have established the above genus, but as far as we can understand Verrill's description of the spicules, our form differs sufficiently to justify us, pending further knowledge, in establishing it. The nutrient canals closely resemble those met with in *Plexaura*, while the cœnenchyma is quite granular, owing to the layer of warty and one-sided club-shaped spicules.

*Callistephanus koreni*, n. sp. (Pl. XXIX. figs. 2, 2a; Pl. XXXIII. fig. 7).

The colony, so far as can be ascertained from the examination of some fragments taken from the tangles of the dredge, would appear to consist of an axis, somewhat feebly branched. The main stem (or branch) is about 2 mm. in diameter, and gives origin to three branches from 7 to 8 cm. long. These are given off at right angles, and from them other smaller twigs arise, at intervals of from 5 to 15 mm.; these again give rise to other twigs, all of which arise in the same plane and at right angles, so as to give a somewhat broadened fan-shaped form to the colony. The polyps arise from prominent verrucæ, which are situated laterally and alternately, the space between the polyps of the one side being from 3 to 4 mm. The larger verrucæ are 1.5 mm. in height and 2 mm. broad. The polyps are completely retractile; the bodies are first retracted and then the tentacles are brought together and then withdrawn within the prominences of the verrucæ; they are not incurved, the edges of the verrucæ can to a certain extent close in over them, leaving an eight-rayed opening. On the smaller branches the polyps are often much closer together.

The cœnenchyma is moderately thick, rough; consisting of a layer of warty spindles, warty and one-sided clubs, often spiny. The bodies of the polyps are furnished with spiny spindles, while fine needle-shaped spicules are found supporting the outward basal surfaces of the tentacles. The spicules of the cœnenchyma measure, the spindles 0.4–0.6; 0.34–0.04; 0.3–0.04; 0.24–0.04; 0.2–0.04 mm.; the warty clubs 0.18–0.12 by 0.06 mm. in their widest diameter; the one-sided clubs 1.08; 0.08–0.06 mm.; the irregular four-rayed form 0.24–0.08 mm. The spicules in the tentacles measure 0.1–0.04; 1–0.02 mm.

The colour in spirits of wine is a bright red.

*Habitat*.—Fragments of this very beautiful species were dredged at Station 344, off the Island of Ascension, from a depth of 420 fathoms. They had to be disentangled from the hempen tangles; so that the attachment and perfect shape of the colony remains unknown.

Genus *Lophogorgia*, Milne-Edwards.

*Lophogorgia*, Milne-Edwards, Hist. Nat. des Coralliaires, vol. i. p. 167.

*Gorgonia*, K  lliker (*pars*), Icones Histiol., p. 139.

*Leptogorgia*, Verrill (*pars*), Amer. Journ. Sci. and Arts, vol. xlviii. p. 425.

This genus was formed by Milne-Edwards for *Gorgonia palma*, Esper non Pallas, the *Gorgonia flammea*, Ellis and Solander; it must not be confounded with *Gorgonia palma*, Pallas, which is a Euniceid, near *Eunicella*, Verrill. We are not able to follow K  lliker's plan of sinking this and other genera under the common denomination of *Gorgonia*, and we venture to differ from Verrill, who places *Lophogorgia* as a section of the emended genus *Leptogorgia*.

*Lophogorgia* is here retained for those G  rgonids with more or less flattened stems and branches, these latter spreading in nearly the one plane and sometimes being cylindrical at their growing tips. The polyps are retractile within the c  nenchyma, without verruc  . The larger nutrient canals are on the flattened portions of the stem to be found on the flattened surfaces, though in the cylindrical twigs they are symmetrical.

The genus would come next to *Leptogorgia*.

*Lophogorgia lutkeni*, n. sp. (Pl. XXX. figs. 1, 1  ; Pl. XXXIV. fig. 1).

Colony attached by a disc-like base; branched, branches arising in the one plane. Axis horny, flexible and compressed. The branches, which are also somewhat compressed, are given off at irregular intervals, sometimes continuing simple, at other times once again branching. Height of the colony 240 mm., the widest diameter of the main stem is 3 mm., and the principal branches have the same diameter. The main stem and branches are marked on both surfaces with an irregular wavy line.

The c  nenchyma is moderately thick, granular, containing numerous warty double spindles.

The polyps are numerous and occur on both the stem and branches; the verruc   are very slightly elevated. The central portion of both the main stem and the branches on both surfaces are destitute of polyps. The polyps are completely retractile. The tentacles are well furnished on their dorsal surfaces with slender needle-shaped spicules. When the polyps are completely withdrawn, the verruc   present the appearance of oblong slits, but there is a considerable difference in their size, the long diameter varying from 1.5 to 2.5 mm. The spicules of the c  nenchyma are warty spindles, measuring 0.2-0.04; 0.3-0.02; 0.34-0.02; 0.2-0.025; those of the tentacles are needle-shaped, feebly spined, sometimes curved, and measure 0.3-0.02; 0.12-0.02; 0.22-0.02; 0.16-0.04 mm.

The colour in spirit is a dull yellowish-red.

*Habitat*.—Station 145A, off Prince Edward Island; depth, 310 fathoms.

*Lophogorgia flammea* (Ellis and Solander).*Gorgonia flammea*, Ellis and Solander, Hist. of Zoophytes, p. 80, pl. ii. 1786*Gorgonia palma*, Esper, Pflanzenthier, p. 32, tab. v.*Non Gorgonia palma*, Pallas, Elench. Zooph., p. 189.

A portion of a colony of this species in excellent preservation is in the collection; the bottle in which it was stored had lost its label, but in it there was also a fragment of *Leptogorgia lutkeni* from Prince Edward Island, and as the original specimen of *Gorgonia flammea*, E. and S., came from the Cape of Good Hope, it seems not unreasonable to assume that the present specimen was taken either in Simon's Bay or in the dredgings off Prince Edward Island.

Genus *Leptogorgia*, Verrill (*emend.*).*Leptogorgia*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 163.

Verrill<sup>1</sup> emends this genus so as to make it include "all those Gorgonids having a horny axis, thin cœnenchyma, finely granulous at the surface, and composed of very small warty spicules in the form of longer and shorter double spindles, usually mingled with more or less numerous small heads and double heads, the polyp spicules long and slender, simple, with few warts. The cells are usually arranged in lateral rows or bands, and may be either flat or more or less elevated on verrucæ."

As so constituted, this genus embraces a very well marked group, but excluding *Lophogorgia*; most of the species are shallow-water forms.

*Leptogorgia purpurea* (Pallas) (Pl. XXIX. fig. 1; Pl. XXXIV. fig. 3).*Gorgonia purpurea*, Pallas, Elench. Zooph.*Gorgonia pumicea*, Valenciennes, Comptes rendus, t. xli. p. 12.*Gorgonia pumicea*, Val., Milne-Edwards, Hist. Nat. des Coralliaires, tom. i. p. 160.*Leptogorgia pumicea*, Verrill, Amer. Journ. Sci. and Arts, Nov. 1869, p. 421.

There are two specimens of this species in the collection taken off Bahia, the smaller is that figured; another specimen was dredged off the coast at Chili, and in considerably greater depths. This species is recorded by Milne-Edwards from Brazil, and by Verrill from Rio Janeiro. It is not without interest to find it extending its geographical area round South America, as far as Chili. Except in a slight difference in the shade of red colour the specimens are alike. The spicules of the cœnenchyma are chiefly oblong spindles with from two to four zones of wart-like prominences; these measure 0·12–0·04; 0·08–0·03; 0·06–0·03 mm., and broader spindles almost oval in outline measuring 0·08–0·06; 0·06–0·04 mm. In the polyps the spicules are flat, irregular in out

<sup>1</sup> *Amer. Journ. Sci. and Arts*, vol. xlviii. p. 420, 1869.

more or less jagged at the edges. They measure 0·16–0·04; 0·08–0·03; 0·1–0·05 mm. All the spicules are of a light colour.

*Habitat*.—Bahia; depth, 10 to 20 fathoms.

Station 310, Sarmiento Channel; depth, 400 fathoms; bottom, blue mud.

*Leptogorgia arbuscula* (Philippi) (Pl. XXXIV. fig. 4).

*Plexaura arbuscula*, R. A. Philippi, Archiv f. Naturgesch., Jahrg. xxxii. Bd. i. p. 118, 1866.

Dr. R. A. Philippi, in his brief descriptions of some Chilian Zoophytes (*loc. cit.*), gives the following description of an Alecyonarian which he believes to be near to *Plexaura miniacea*, Ehrbg. "Pl. 4–6 pollicaris, a basi inde in formam fruticuli divisa, rosea-coccinea; ramis subdichotomis, omnibus libris; ramulis ultimis  $1\frac{2}{3}$  lin crassis."

A specimen in the Challenger collection from Patagonia may perhaps be referred to this species, though Philippi's description leaves a good deal to be desired.

The colony, attached by a small disc, is branched, branches all in the one plane; the total height of the colony is 150 mm., with a diameter of the main axis at its base of 2 mm. At a height of about 30 mm. from the base a branch is given off from both sides, that to the right attains a length of 115 mm., it divides into several smaller branches, which are given off in nearly the same plane as the larger branch; of these several again divide and ramify. The branch to the left is 80 mm. long, and gives origin to four very short and simple twigs. Above the two chief branches other branches are given off from the main stem at intervals of from 10 to 20 mm., these are either simple or but feebly branched.

The axis is horny, fibrous, tough, with very fine terminal prolongations. The cœnenchyma is thin; the outer layer with warty spindles. The polyps are arranged in a lateral manner on the branches; on the lower portions of the stem and of the large branches they are not very numerous; there are distinct verrucæ; both polyps and their tentacles are retractile, leaving oval slit-like openings in the cœnenchyma.

The spicules of the cœnenchyma are but feebly calcareous. The spiny spindles, which are irregular in form, measure 0·36–0·04; 0·3–0·03; 0·24–0·04; 0·2–0·025; 0·2–0·04 mm. Those of the polyps measure 0·12–0·02; 0·1–0·02 mm.

The colour in spirits is a brick-red.

*Habitat*.—Station 308, off Tom Bay, Patagonia; depth, 175 fathoms; bottom, blue mud.

*Leptogorgia torresia*, n. sp. (Pl. XXXIV. fig. 2).

The colony is branched in various planes; forming a bushy mass of about 400 mm. in height and 5 mm. in diameter at its base. The main axis springs from an irregular creeping base, which grows over part of the valve of a Mollusc, and measures 30 by

20 mm. The first branch is given off at a height on the stem of 30 mm.; at about 45 mm. in height the main stem seems to bifurcate, and each of the subdivisions gives origin to a series of smaller branches, which again and again subdivide. The terminal twigs are very long and slender (200 mm.).

The axis is horny but brittle. The cœnenchyma is moderately thick. There is a spiral marking on the lower portion of the stem which ramifies along and is lost in the branches.

The polyps are arranged on the main stem in a somewhat irregular manner, but on the smaller wire-like branches they are placed in opposite rows. The polyps are completely retractile and when closed the verrucæ appear but slightly elevated.

The warty spindles of the cœnenchyma measure 0·12–0·04; 0·1–0·04; 0·08–0·04; mm. The few quadriradiate forms are 0·06–0·06 mm.; those of the polyps 0·08–0·02; 0·06–0·02 mm.

The colour in spirits is a pale yellow hue.

*Habitat*.—Torres Strait.

This species in several respects resembles *Leptogorgia australiensis*, Ridley.

#### Genus *Gorgonia*, Verrill.

We agree with Verrill<sup>1</sup> in restricting this genus to those species of Gorgonids having small double spindles along with small bracket-shaped or crescent-shaped spicules; these latter corresponding to those called “Klammern” by Kölliker;<sup>2</sup> which very characteristic form has been well called “scaphoid” by Saville Kent,<sup>3</sup> on account of the resemblance to a small canoe with men in it.

This genus corresponds to the second division of Kölliker's *Gorgonia*.

*Gorgonia flabellum*, Linn.

Several specimens of this well-known species were taken at moderate depths off the Bermudas.

#### Family VII. GORGONELLIDÆ.

*Gorgonellaceæ*, Valenciennes, Comptes rendus, t. xli. p. 14.

„ Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 182.

„ Kölliker (*pars*), Icones Histiol., p. 140.

We adopt this family in the sense of Kölliker's division D. of the subfamily I. Gorgoninæ, only excluding the genus *Rüsea*, D. et M. (see *antea*, p. 24), which is the same as *Herophile*, Steenstrup, which latter name should have the priority.

<sup>1</sup> *Amer. Journ. Sci. and Arts*, vol. xlviii. p. 424, 1869.

<sup>2</sup> *Icones Histiol.*, Abth. ii. p. 139, 1865.

<sup>3</sup> *Monthly Micr. Journ.*, 1870, p. 90.

Genus *Scirpearella*, n. gen.

Cuvier<sup>1</sup> in his classification of "Les Polypiers nageurs," of which the axis is stony, but free, describes "Les Scirpéaires" "ont les corps très long et très grêle, et les polypes isolés, rangés alternativement le long des deux côtés," giving as the type *Pennatula mirabilis*, L.

Kölliker<sup>2</sup> gives *Scirpearia*, Cuv., as a synonym of *Funiculina*, Lam., and adds the following under the name of *Scirpearia mirabilis*,—"Cuvier designates an Alcyonarian named and figured by Linneus as *Pennatula mirabilis*; Ellis copies this figure and so also does Pallas. Lamarck refers this species to his genus *Funiculina*. Ehrenberg quotes it as *Scir. mirabilis*, Cuv., and gives as synonyms *Pennatula mirabilis*, L., *Funiculina cylindrica*, Lamk., and *Paronaria scirpea*, Blain., and he mentions that a specimen in the Berlin Museum quite answers to the description of this species."

De Blainville<sup>3</sup> places *Funiculina*, Lam., as a genus next to *Plexaura*, the type species being *Funiculina cylindrica*, Lam., of which he quotes *Pennatula mirabilis*, Pall., as a synonym, adding "et ce qui est assez singulier, c'est que M. Cuvier a en outre proposé un nouveau genre avec la *P. mirabilis*, de Linné, sous le nom de *Scirpearia*, sans penser qu'il étoit établi avec le même animal, type du genre Funiculine de M. de Lamarck."

The *Funiculina cylindrica*, Lam., in the Paris Museum is a Gorgonid, and this very specimen Kölliker thinks (and we agree) is the one figured by de Blainville (it is possibly a *Juncella*). Dr. Gray (1870) accepts the genus *Scirpearia*, Cuv., placing it in his family Calligorgidæ, the next genus to his *Callicella* (see *antea*, p. 75, *Caligorgia*), and in addition to the species *Scirpearia mirabilis*, includes *Juncella funiculina*, D. and M., *Juncella barbadensis*, D. and M., and *Gorgonia moniliformis*, Lam. Dr. Gray's generic diagnosis is unintelligible, *Scirpearia funiculina*, D. and M., is said to have the coral free though it is figured as attached, and the generic characters of Cuvier cannot be said to be in any way emended. Dr. Gray had some years previously (1859) placed *Scirpearia* in his family Elliselladæ, but without any sufficient diagnosis.

Dr. Studer,<sup>4</sup> however, emended the diagnosis of *Scirpearia*, placing it near *Ellisella*, but with prominent polyps, these arranged in two rows; spicules, double clubs and spindles, and including in it *Nicella*, Gray, *Raynerella*, Gray, and *Viminella*, Gray, *ex parte*. Even accepting the genus in the sense of Studer, it seems impossible to include in it, even with considerable further emendations, some remarkable forms with simple or very feebly branched stems found during the expedition of the Challenger, and for them we are compelled to make a new genus which may be diagnosed as follows:—

Colony simple or very feebly branched. Axis calcareous, brittle, smooth or symmetri-

<sup>1</sup> Cuvier, *Le Règne Animal*, Nouv. Édit., t. iii. p. 319, 1830.

<sup>2</sup> Kölliker, *Anat. Syst. Besch. der Alcyonarien*, Die Pennatuliden, p. 261, 1872.

<sup>3</sup> De Blainville, *Manuel d'Actinologie*, p. 508, 1834.

<sup>4</sup> Studer, *Monatsber. d. k. preuss. Akad. d. Wiss. Berlin*, 1878, p. 660.

cally grooved on the surface. Polyps arranged in spirals or sometimes in rows on the stem; tentacles and upper portion of the polyps retractile within prominent verrucæ. Cœnenchyma moderately thick, with spiny spindles and double clubs forming a roughened outer layer. The following four species are from the Pacific Ocean.

The known species of *Scirpearia*, Studer, are from the Atlantic Ocean.

*Scirpearella profunda*, n. sp. (Pl. XXXI. fig. 2; Pl. XXXII. fig. 1; Pl. XXXIV. fig. 7).

The colony is feebly branched; the specimen occurs in fragments, of which that figured on Pl. XXXI. was the first found in the contents of the dredge; afterwards several others were disentangled from the tow, and an attempt to put them together has been made in the figure on Pl. XXXII., which is drawn of the natural size.

The main axis is attached by a calcareous oval disc, 11 mm. by 6 mm.; the stem is slightly curved, and at a height of about 80 mm. gives off one slender simple branch of about 100 mm. in length; a second similar branch is given off in the same plane, and from the same side, at an interval from the first of 10 mm.

The basal diameter of the main stem is 4 mm., and it has the same diameter for some distance beyond the origin of the second branch. The main axis then appears to divide into two terminal branches. The axis is calcareous, brittle, and of a circular outline, with some spiral grooves, it is formed of several concentric calcareous layers which easily peel off; without the cœnenchyma it is 2·5 mm. in diameter.

The polyps are in irregular spirals on the stem and branches, from 2 to 3 mm. apart; closer to one another towards the termination of the branches, with a width at base of 1 mm. While all the polyps are capable of being completely retracted, the older polyps appear to develop a more conical shaped verrucæ than the younger ones, and when the tentacles are folded together, and the polyps invaginate themselves, they do so in a one-sided manner, that portion of the polyp nearer the axis being drawn in more deeply than that furthest off, so that an appearance is presented of a shallow ledge, that reminds one of the edible nests of the swallow (*Callocalia*). Afterwards this flap-like protuberance is also drawn in, leaving an oblong conical verruca, which measures about 2 mm. in its greater diameter. The cœnenchyma is moderately thick, and finely granular; the outer layer consists of double clubs, the inner layer of the same but of a smaller size; in the polyps quadrate or stellate forms and a few needle-shaped spicules with spiny edges are met with; the spicules are very uniform in size. The spindles measure 0·1–0·04 mm.; the double clubs 0·1–0·05; 0·08–0·04; 0·06–0·02 mm.; the stellate forms 0·08–0·08; 0·08–0·06 mm.; the needle-shaped forms 0·06–0·02 mm.

The colour in spirits is a whitish-brown.

*Habitat*.—Station 177, off the New Hebrides; depth, 130 fathoms; bottom, volcanic sand.

*Scirpearrella gracilis*, n. sp. (Pl. XXXI. figs. 1, 1a; Pl. XXXIV. fig. 6).

The colony is simple (as far as can be judged from the few fragments collected). These belong apparently to two separate colonies. The more perfect of these measures 1330 mm. in height, with a diameter, including the cœnenchyma, at the widest (basal?) portion of 2·5 mm., but tapering to the dimensions of a fine thread. Among the smaller fragments there is a terminal piece which ends in an acute apex, just below which are two polyps, opposite to one another; the axis at their base measures 1 mm. in diameter.

The axis is calcareous, very brittle; in the older portion of the stem it is compressed, with a broad diameter of 1·5 mm. and a short diameter of 1 mm. On its broader surfaces it is grooved. The polyps are crowded on the stem in four rows, the polyps in each row alternating with those in the next row, so as to give a more or less spiral arrangement to the polyp colony. This arrangement is sometimes obscured by the addition of young polyps between the older ones. The polyps are retractile, leaving prominent nipple-like verrucæ. The tentacles are first drawn together and in, then the upper portion of the polyp-body becomes invaginated; then the walls of the verrucæ are drawn together, leaving a prominence, with a basal diameter of from 1 to 1·5 mm. and about 1 mm. in height. On drying, these verrucæ often become wrinkled. Towards the apex of the stem the polyps are arranged in three rows, and at the very apex they are opposite.

The cœnenchyma is moderately thick, it and the verrucæ are rough, with a layer of spiny or warty double clubs; beneath these and in the bodies of the polyps are some spiny spindles and stellate forms; minute needle-shaped spicules with toothed edges, and mixed with some stellate forms, occur in and at the base of the tentacles.

The spicules measure as follows:—Warty spindles 0·1–0·04; 0·12–0·06 mm.; spiny spindles 0·16–0·06; 0·14–0·05; 0·12–0·02 mm.; double clubs 0·08–0·04; 0·1–0·04 mm.; stellate forms 0·06–0·06; 0·1–0·08 mm.; needles 0·04–0·02; 0·06–0·02 mm.

The colour in spirits is a brownish-white.

*Habitat*.—Station 177, off the New Hebrides; depth, 130 fathoms; bottom, volcanic sand.

This species and the preceding were taken at the same haul of the dredge, from a depth of 130 fathoms; although no doubt closely related forms, there seem sufficient differences to justify their being for the present treated as distinct.

*Scirpearrella moniliforme*, n. sp. (Pl. XXXIV. fig. 8).

In two specimens the colony seems simple, in a third, and that the largest, it has a single branch. In this latter the axis is attached by a disc, 15 by 10 mm., and it has a total length of 505 mm. The branch comes off at a height of 215 mm. from the base.



The stem with cœnenchyma is 1.5 mm. in diameter at its base, and preserves the same diameter until the branch is given off, when it gradually tapers to a fine end. The other two specimens with simple unbranched stems attain a height of 325 mm.

The axis without the cœnenchyma is very deeply grooved; ten grooves can be very easily counted on the older portion of the axis, but these diminish to two at the apex. These ridges show through the cœnenchyma as linear furrows.

The polyps are arranged on the stem, the lower portion in four irregular rows; towards the apex they are alternate and arranged on either side of the stem, while for the first 60 mm. of the stem, counting from the basal disc, they are absent. They are retractile within the well-marked but shallow verrucæ; these latter measure at their base 1 mm. An occasional verruca will be found larger and more elevated than the rest, measuring 1.5 mm. in diameter and the same in height; these generally are to be found near the summit of the axis.

The cœnenchyma is thin, with a layer of spiny spindles, with some warty clubs mixed throughout. The polyp spicules are minute needle-shaped and stellate forms.

The spicules measure—the spindles 0.18–0.06; 0.12–0.04; 0.08–0.04; 0.06–0.02; 0.04–0.02 mm.; the clubs 0.14–0.04; 0.16–0.06; 0.14–0.08 mm.; the stellate forms 0.12–0.06; 0.1–0.06; 0.1–0.04 mm.; the needle-shaped forms 0.04–0.02; 0.03–0.02 mm.

While closely related to *Scirpearella gracilis*, the form of the axis and of the spicules will distinguish between the two.

The colour in spirits is white.

*Habitat*.—Amboina; depth, 100 fathoms.

*Scirpearella rubra*, n. sp. (Pl. XXXIV. fig. 5).

Colony (so far as can be judged by the single fragment) simple, the stem (in two pieces) measures 620 mm. in length, but was evidently much longer; at the supposed base it measures 2 mm. in diameter, and at the other extremity it tapers to 0.75 mm. The axis is calcareous, brittle, with two shallow grooves.

The polyps are numerous, arranged in spirals on the stem. Towards the termination of the axis the polyps are arranged in an alternate manner, on the opposite sides of the stem. They are retractile within moderately developed verrucæ. The spirals are about 1.5 mm. apart, and the closed oval verrucæ are about 1.5 mm. in their broadest diameter; they seem when partly closed to be bilabiate.

The cœnenchyma is thin, with a compact layer of spiny spindles and warty clubs. In the polyps the spicules are stellate, with a few needle-shaped forms. They are of a light sherry colour. The spindles measure 0.1–0.06; 0.08–0.04 mm.; clubs 0.12–0.06; 0.1–0.06 mm.; the stellate forms 0.1–0.06; 0.1–0.08; 0.08–0.08 mm.; the needle forms 0.06–0.02 mm.

Colour in spirit a light red.

*Habitat*.—Station 232, *Hyalonema*-ground, off Japan; depth, 34½ fathoms; bottom, green mud.

Genus *Juncella*, Valenciennes, *ex parte*.

*Juncella*, Valenciennes, Comptes rendus, tom. xli. p. 14.

*Juncella*, Kölliker, Icones Histiol., Abth. ii. p. 140.

*Juncella gemmacea* (Valenciennes) (Pl. XXXIV. fig. 13).

*Gorgonia gemmacea*, Val., on label in Museum, Paris.

*Ferrucella gemmacea* (Val.), Milne-Edwards, Hist. Nat. des Coralliaires, p. 185, pl. B.2, fig. 7.

*Juncella gemmacea* (Val.), Kölliker, Icones Histiol., Abth. ii. p. 140.

*Ellisella gemmacea* (Val.), Gray, Cat. Lithophytes Brit. Mus., p. 26.

One specimen, torn from its attachment and measuring 975 mm. in length, with a diameter at its basal portion of 7·5 mm. which tapers to one of 25 mm. at its terminal portion, occurs in the collection. The groove on either side of the axis is well marked.

The following are average measurements of the spicules:—the unsymmetrical double clubs 0·12–0·04; 0·1–0·03; 0·1–0·02; 0·08–0·02 mm.; the double stars 0·12–0·08; 0·1–0·04 mm.; these two forms of spicules seem to merge into one another, when the smaller head of the unsymmetrical club enlarges to the same size as the opposite head, and the spiny outgrowths become fewer and more prominent, then the result is a double star; needle-shaped spicules measure 0·06–0·02 to 0·1–0·02 mm.

The colour in spirits is an orange-red.

*Habitat*.—Station 186, Torres Strait; depth, 8 fathoms; bottom, coral mud.

Red Sea, Valenciennes; Queensland, Ridley; Mermaid's Straits, North-west Australia, Studer.

*Juncella juncea* (Pallas), var. *alba* (Pl. XXXIV. fig. 12).

*Gorgonia juncea*, Pallas, No. 172, Esper, Fortsetz., p. 177, tab. lii.

*Juncella juncea*, Val., Comptes rendus, tom. xli. p. 14.

A large number of fragments collected, which seem to belong to at least seven colonies, must be referred to Pallas' well-known species. They differ in colour from the type, it being of an orange-red colour, while those found by the Challenger are of a nearly pure white.

In two instances the whole colony has been torn from its attachment, and an examination of the larger of these shows that it was rooted in a mass of sponges and Polyzoa; in the other there was in addition a well-marked side attachment, which is calcareous, and partly creeping over a dead Zoantharian Coral. The height of the larger of these specimens, not counting the root-like portion, is 675 mm., with a broad basal diameter of 7·5 mm. and an apical one of 3 mm.

The largest of the imperfect fragments measures about 750 mm. in height and is 13 mm. in its widest diameter. In several cases the apices seem to have been browsed off and are in process of regrowth.

The structure of the axis very closely resembles that described by Kölliker as characteristic of his genus *Plexaurella*; being made up of alternate layers of horny and calcareous portions; the horny and calcareous portion of the largest specimen in the collection is slightly oval, and measures 5.5 by 4.5 mm. The cœnenchyma is very thick in this specimen, measuring 3 mm.; the spicules are very uniform in size; the double stars vary from 0.08–0.04 to 0.1–0.05 mm.; while the unsymmetrical clubs have a range of between 0.08–0.03 and 0.1–0.3 mm.; occasionally a longer one, 0.12–0.04 mm., is seen.

*Habitat*.—Torres Strait; depth, 7 to 11 fathoms.

*Juncella barbadensis*, Duchassaing and Michelotti (?) (Pl. XXXIV. fig. 14).

*Juncella barbadensis*, Duch. and Mich., Mém. Corall. des Antilles, Suppl., p. 22, pl. v. fig. 5.

Two small fragments are in the collection, which may possibly be juvenile states of *Juncella barbadensis*, D. and M., or of *Juncella funiculina*, D. and M., but from the very brief description of these species by the authors, the absence of type specimens to refer to, and the very small amount of material at our disposal, it seems impossible to decide the point with any certainty.

The colonies measure 150 and 155 mm. in length. The polyps are arranged on them in four rows; they are retractile with very long peduncles (2.5 mm. in length), which bend in towards the stem in a manner reminding one of the figures of *Scirpearia mirabilis*, Cuv. The cœnenchyma is thin and the spicules seem most closely related to those of the preceding species. The unsymmetrical clubs measure 0.1–0.4 mm.; across head 0.2 mm.; across stem 0.08–0.04; 0.06–0.04; 0.04–0.02 mm.; the double stellate forms 0.06–0.04; 0.06–0.02 mm.; the spindles 0.1–0.25; 0.06–0.2 mm.

In some respects this form resembles *Juncella flexilis*, Std., from Mauritius.

*Habitat*.—Station 23, off Sombrero Island; depth, 450 fathoms; bottom, Pteropod ooze.

*Juncella racemosa*, n. sp. (Pl. XXXIV. fig. 11).

Colony attached, branched; branches arising in the one plane. There are no quite perfect specimens in the collection, but the two most perfect ones measure 115 and 140 mm. in height, with a diameter at the base of 1.5 and 3 mm. respectively. In the smaller specimen all the branches, until the very summit, are given off from the right side of the main stem, which is curved; several of these branches are short and simple; the longest, which is itself branched, extends to a length of 75 mm.; all the branchlets

from these are given off from the one side of the branches, and when themselves branched to a third degree, the same fact holds true. This mode of growth is very constant and it gives a graceful, semi-pendulous outline to the colony. The larger branches are of about the same thickness as the main stem. The axis is calcareous, brittle, with a thin cœnenchyma containing the characteristic spicules of *Juncella*.

The polyps are numerous both on the stem and branches, prominent. The tentacles fold in over the oral region of the polyp, and during the various stages of contraction the apex of the polyp body shows an eight-rayed star, formed of the basal portions of the infolding tentacles; when the contraction proceeds still further, a simple papilla is to be seen. The fully contracted verruca measures about 1 mm. in height and 0.5 mm. in width. On one surface of the stem and branches the polyps are absent, and on this naked portion a feebly marked groove may be seen winding up the stem. The polyps are much more numerous and crowded on the smaller branches, where they are placed in three or four rows.

The spicules are very uniform in size, many of the clubs are of an amber colour, the unsymmetrical clubs measure from 0.06–0.04 to 0.06–0.2 mm.; the double stars from 0.08–0.02 to 0.08–0.04 mm.; the needle-shaped spicules in the polyps, especially at the base of the tentacles, measure from 0.1–0.04 to 0.06–0.04 mm.

The colour of the cœnenchyma and the polyps varies from a reddish-yellow to a dark red. The bases of the polyps and the tentacles are of a much lighter hue.

*Habitat*.—Station 232, *Hyalonema*-ground, off Japan; depth, 345 fathoms; bottom, green mud.

#### Genus *Ellisella*, Gray (*emend.*).

*Ellisella*, Gray, Proc. Zool. Soc. Lond., p. 257, 1857.

„ Gray, Cat. Lithophytes Brit. Mus., p. 25, 1870.

„ Gray, *emend.*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 659, 1878.

Dr. Gray in 1857 (*loc. cit.*) established this genus for *Gorgonia juncea*, Pallas, *Gorgonia elongata*, Pallas, and *Gorgonia pectinata*, Pallas. Afterwards (1870) in his Catalogue he limited the genus to *Gorgonia elongata*, Pallas, and allied forms, referring the first and the last of the above-quoted species to the genera already established for them by Milne-Edwards. Studer (1878) emended Gray's generic diagnosis and added two new species, *Ellisella calamus* and *Ellisella maculata*, both from Mermaid's Straits in North-west Australia.

#### *Ellisella maculata*, Studer (Pl. XXXIV. fig. 9).

*Ellisella maculata*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 659, taf. iv. fig. 27, a, b, c, 1878.

One fragment of this species from Torres Strait in the collection is unbranched; it is about 150 mm. in length, from what appears to be its basal portion, with a diameter of

3·5 mm. to one of 2 mm. The polyps are arranged in spirals around the stem, leaving a very narrow median groove.

A second example from Banda, is 225 mm. in length, being evidently a portion of a terminal branch; it is furnished with one short branch. In this specimen the median groove is better marked. The cœnenchyma is thick. The polyps are only partially retractile. The spicules measure:—the spindles, which are of a salmon colour, 0·12–0·04; 0·08–0·02; the double clubs, sherry coloured, 0·1–0·06; 0·06–0·04; the needles 0·06–0·2.

*Habitat.*—Torres Strait and Banda Island.

Genus *Gorgonella* (*pars*), Valenciennes.

*Gorgonella*, Valenciennes, Comptes rendus, t. xli. p. 14.

„ Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 183, 1857.

„ Val. (*ex parte*), Kœlliker, Icones Histologicæ, Abth. ii. p. 39

*Gorgonella orientalis*, n. sp. (Pl. XXXIV. fig. 10).

A large branch, with many detached fragments occurs in the collection from Japan. The whole series of pieces evidently formed portions of an extensive colony. It may be described as follows:—

Colony much branched; the largest branch (in the collection) is about 275 mm. in length; from it as a main branch both large and small branchlets arise, they are given off from either side of the main branch, and in the one plane. The basal diameter of this branch is 5·5 mm., it then gradually tapers to a twig of not quite 1 mm. in diameter. One of the branches arising from it has a basal diameter at its origin of 4 mm.; it extends to a length of 150 mm. The entire colony in all probability assumed a fan-shape. There is an occasional anastomosis between the branches of the third series (regarding the branch described as a main stem).

The axis of this branch is horny, with a central calcareous core; but the smaller twigs and branches are extremely brittle. The polyps are numerous, occurring quite irregularly over the surface of the larger branches; but on the smallest twigs they seem to be arranged in three rows. Two opposite polyps end the twigs, giving a knob-like appearance to the terminations. The polyps are prominent, with retractile tentacles, and are themselves nearly retractile, within almost flat verrucæ; this seems to be more the case on the older portions of the stem; on the younger portions the verrucæ are more elevated. The verrucæ have a broad diameter of 1 mm., and when closed a maximum height of the same. When quite withdrawn the eight rays on the summit of the verrucæ alone mark out their existence; but this appearance seems often wanting.

The cœnenchyma is moderately thick, granular, with the double club-shaped spicules of a brownish-yellow hue; beneath these there is a layer of smaller spicules, chiefly spiny

spindles, which line the walls of the nutrient canals. The spicules measure :—the spindles 0·12–0·02 mm., these are mostly around the nutrient canals; the double clubs 0·1–0·04; 0·08–0·04 mm., these are on the surface of the cœnenchyma; the double clubs with few spines from the bodies of the polyps measure 0·06–0·02; 0·04–0·02 mm.; the stellate forms, the large ones 0·02–0·02 mm.; the small, 0·06–0·06 mm.

This species seems very nearly related to *Raynerella aurantiaca*, Gray, from Bass Strait.

*Habitat*.—Station 232, *Hyalonema*-ground, off Japan; depth, 345 fathoms; bottom, green mud.

## Section II. SCLERAXONIA.

### Family I. BRIAREIDÆ.

Scleraxonia in which the axis consists of spicules. There is a more or less well-marked cœnenchyma, in which the polyps are lodged.

The colony may be either spreading over the surface of foreign substances, or may form upright simple or branching masses, the stems of which are sometimes cylindrical, sometimes broadly channelled.

The axis may or may not be penetrated by the nutrient canals, and this difference serves to divide the family into the two subfamilies of Briareinæ and Spongioderminæ.

### Subfamily 1. BRIAREINÆ.

#### Genus *Suberia*, Studer.

*Suberia*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 666, October 1878.

Colony simple or branched, erect. Axis consisting of spindle-shaped spicules, not agglutinated together, and some horny material; traversed by the nutrient canals. Cœnenchyma thick, containing spiny spindle-shaped spicules. Polyps retractile within well-marked verrucæ; standing at right angles to the stem and branches. The polyp spicules are long and bent spindles.

This genus was established by Studer for *Suberia kollikeri*, from the north of New Zealand, in 90 fathoms, and for *Suberia clavaria*, from the east coast of South America. In some respects this genus resembles the genus *Solenocaulon*, which was established by Dr. Gray for *Solenocaulon tortuosum*, from North-west Australia. Genth's species, *Solenocaulon tubulosum*, came from the Philippines, while a third species, *Suberia grayi*, is described (*loc. cit.*, p. 668) by Studer, also from North-west Australia (Mermaid Straits).

Dr. Studer emended Dr. Gray's diagnosis of *Solenocaulon* so as to include his new species. Köl liker would apparently confine the genus to species with flattened,

guttered, or channelled stems, but in some instances at least the forms of the axes are very protean, sometimes creeping over fallen Gorgonid stems, and at others growing with flattened upright branches from such stoloniferous masses, and even assuming the form of short cylindrical stems. No doubt a thorough revision of the species of both these genera is required, but the material is not at present available for such a task.

Under these circumstances it seems advisable not at present to form a new genus for a new species from Australia, in which the upright axes are very cylindrical in outline, and we venture to place it in *Suberia*,

*Suberia genthi*, n. sp. (Pl. XL. fig. 1).

The colony forms at first an incrusting surface growing over the long, denuded stems of a *Gorgonia*. These were apparently grown over when lying horizontally on the ground. On reaching the termination of the foreign axis, and on several occasions at intervals along its length, little upright stems arise, sometimes simple, but sometimes branched; these are perfectly cylindrical in form and never show the slightest tendency to anastomose. One of these upright branches rises from the incrusting basal portion to a height of 80 mm., with a diameter of 2·5 mm. At 10 mm. from the base a second small branch arises, extending to a length of 30 mm., when it bifurcates into two branches of 15 mm. each in length, shortly after the origin of this a second branch is given off, but not in the same plane, and reaches a length of 25 mm.; the main axis of this colony itself terminates in two small branches.

The polyps are numerous both on the incrusting and stem-like portions, they are not confined to any limited area, they are retractile within verrucæ, which latter can also apparently become so contracted as not to project much beyond the surface of the coenenchyma; when so contracted they show an eight-rayed outline. The polyps are not terminal.

There is a well-developed coronet of long and bent spindle-shaped spicules below the tentacles, which are themselves armed with spicules.

The nutrient canals in the cylindrical portion of the axis run in the circumference of the axis, but others can be detected in the central portion. There is no well-marked central axis.

The straight warty spicules measure 0·34–0·1; 0·34–0·06; 0·3–0·06; 0·28–0·06; 0·24–0·06; 0·14–0·1; 0·09–0·08 mm. The bent warty spindles measure 0·3–0·1; 0·24–0·12 mm. The irregular branched spicules are 0·24–0·06 mm. in widest diameter. The four-rayed forms 0·32–0·06; 0·2–0·12 mm. The long spiny bent and curved spindle 0·4–0·04; 0·24–0·4 mm. Some double crosses measure 0·1–0·025; 0·08–0·01 mm.

*Habitat*.—Shallow water, off Port Jackson.

## Subfamily 2. SPONGIODERMINÆ.

Genus *Iciligorgia*, Duchassaing, *emend.* Ridley.

? *Iciligorgia*, Duchassaing, *Revue des Zoophytes des Antilles*, p. 12, 1870.

*Iciligorgia* (*emend.*), Ridley, *Rep. Zool. Coll. H.M.S. "Alert,"* p. 351, 1884.

In Ridley's account of the Aleyonaria found during the voyage of H.M.S. "Alert" in the Indo-Pacific Oceans, he adopts Duchassaing's genus *Iciligorgia* for a species found in Torres Strait. A specimen of Ridley's species (*Iciligorgia orientalis*) is in the Challenger collection from the same locality, but it seems to us a matter of doubt whether this species be rightly referred to Duchassaing's genus, which was made for a species (*Iciligorgia schrammi*) found at Guadaloupe.

Duchassaing's diagnosis is as follows—"Axis mollis, spongiosus, spiculis faretus; cortex tenuis, spiculis aciniformibus formatus; calycibus mammæformibus, obtusis, in utroque latere ramorum uniseriatis. Genus situ Polyporum, axe corticeque interse distinctis, a Briareis recedens, Polypis utroque latere uniseriatis, a Paragorgiis diagnoscutur."

To this is added that the "circulatory canals" are as in *Briarea* and that the *Gorgonia* (*Titanideum*, Verrill, 1864) *suberosa* of Ellis is closely allied thereto.

No specimen of this genus exists in the museum at Turin, but we think it better to accept the genus, as emended by Ridley, leaving it to future investigations to determine the question as to whether it is identical or not with that described by Duchassaing.

*Iciligorgia orientalis*, Ridley (Pl. XXX. fig. 2).

*Iciligorgia orientalis*, Ridley, *loc. cit.*, p. 351, pl. xxxvii. figs. F, F"; pl. xxxviii. fig. e.

The specimen in the collection consists of what appears to be but a portion of a colony. What seems to be its main axis is about 230 mm. in height, with a basal diameter of 17 mm., tapering in the branches to one of from 2 to 3 mm. The branching is very irregular, though with a decided unilateral tendency. Possibly owing to the strength of the spirits in which the specimen was preserved, the cœnenchyma is somewhat contracted and wrinkled. The main stem is flattened in outline, being 17 mm. long by 8 mm. wide, but the terminal tips of some of the branches are nearly circular.

The polyps are found scattered irregularly over the surface of the stem and branches, sometimes solitary, and very slightly prominent; at other times and more frequently in narrow clefts of the cœnenchyma, with lip-like edges, between which the polyps are completely retractile; these are the "knife-like" edges of Ridley, but in the Challenger specimen they are not exclusively confined to the lateral margins of the branches; sometimes even three such wavy, linear slits will be found on a single branch.



The spicules have been well described by Ridley. The longitudinal canals form a well-marked boundary between the axial portion of the stem and the cœenchyma.

The colour in spirits is a creamy yellow; when dry the colony is very brittle.

*Habitat*.—Torres Strait.

## Family II. SCLEROGORGIADÆ.

*Sclerogorgiaceæ*, Kölliker, *Icones Histiológicæ*, Abth. ii. p. 142.

Kölliker established the subfamily *Sclerogorgiaceæ* as a subfamily of *Gorgonidæ* (*loc. cit.*), to receive the species *Gorgonia suberosa*, Pallas, Esper, and *Gorgonia verriculata*, Esper. He characterised it as consisting of "Gorgonids with unjointed axes, composed of a horny substance and agglutinated calcareous spicules. Cœenchyma as in *Gorgonia*." For the genus he proposed the name *Sclerogorgia*, but Dr. Gray had some years previously made the genus *Suberogorgia*<sup>1</sup> for the first mentioned of Esper's species. While retaining Kölliker's expressive name for the larger group, we feel compelled to adopt Gray's generic appellation.

This subfamily of Kölliker's forms our second family of this section. In it the central axis, even to the very summit of the youngest branches, is found to consist of long spindle-shaped spicules, which are but feebly calcareous and which become intercalated and agglutinated together, forming an elastic axis, which effervesces, but loses little of its bulk under acids; the outer layers of the spicules being perhaps more easily affected than the innermost ones, but a large proportion of horny material remains after prolonged soaking in acid. The nutrient canals are on either side of the axis, forming a mesh with the canals in the cœenchyma. The polyps are placed on the sides of the stem and branches, either with or without verrucæ. The cœenchyma is moderately thin, the spicules being either large spindles, warty double spindles or double wheels. The polyp spicules are small warty spindles. The polyps are completely retractile.

### Genus *Suberogorgia*, Gray, *emend.*

*Suberogorgia*, Gray, *Proc. Zool. Soc. Lond.*, 1857, p. 159.

*Pterogorgia* and *Rhipidogorgia* (*pars*), Milne-Edwards, *Hist. Nat. des Coralliaires*, t. i. p. 167.

*Pterogorgia*, Dana (*pars*), *Zooph.*, p. 647.

*Sclerogorgia*, Kölliker, *Icones Histiológicæ*, Abth. ii. p. 142.

„ Studer, *Monatsber. d. k. preuss. Akad. d. Wiss. Berlin*, 1878, p. 666.

*Suberogorgia*, Ridley, *Zool. Coll. H.M.S. "Alert,"* p. 349.

*Rhipidella*, Gray, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. v. p. 407.

Dr. Gray's description of this genus is as follows:—"Coral furcately branched, rather compressed, with a continued sunken groove up the middle of each side. Cell rather

<sup>1</sup> *Proc. Zool. Soc. Lond.*, 1857, p. 159.

prominent, convex, in two or three rather irregular series up each edge. Axis pale brown, wart-like, formed of rather loosely concentric fibrous laminæ, containing a large quantity of calcareous matter, and effervescing with muriatic acid. The bark when dry is rather thin, smooth, hard and granular within" (*loc. cit.*, p. 159).

To this Kölliker, while changing the generic name to *Sclerogorgia*, adds—"The spicules of the cœnenchyma are thickly warted spindles, yellow or colourless, of from 0·10 to 0·16 mm. in length, besides some simple forms which in *Sclerogorgia verriculata* appear as birotate spicules, with the edges of the wheels toothed. The polyp spicules, small warty spindles arranged as usual."

Dr. Gray's generic appellation, however feebly diagnosed, has without doubt the priority. The two species figured and described by Esper are in the Challenger collection; a third species is referred to by Kölliker, without any description or locality given, under the name of *Sclerogorgia patula* (Ellis), as from the Vienna Museum. Ellis's species, which he received preserved in spirits, was found in the Mediterranean and sent to him by the celebrated Donati. It is a branched and partly pinnate form of a very bright red colour; but it would be difficult from the short description to recognise the species.

A fourth species from Japan, here described as new, requires a slight emendation of the genus, the diagnosis of which may stand as follows; the peculiar structure of the axes, so well described by Kölliker, we call sclerogorgic.

Colony branched, branches either simple or anastomosing. Central axis of stem and branches "sclerogorgic," nutrient canals on either side of axis; cœnenchyma thin, friable. Polyps completely retractile, with or without verrucæ. Spicules spindles, double spindles, spiny or warty; birotate, or in the polyps needle-shaped.

The following species of this genus were found during the voyage of the Challenger:—

#### 1. *Suberogorgia suberosa* (Pallas).

*Gorgonia suberosa*, Pallas, Elench. Zooph., p. 191.

„ „ Esper, Fortsetz. der Pflanzenthier, p. 170 (not *Gorgonia suberosa*, Ellis and Solander).

*Suberogorgia suberosa*, Gray, Proc. Zool. Soc. Lond., 1857, p. 159.

*Sclerogorgia suberosa*, Kölliker, Icones Histilogicæ, p. 142, 1865.

*Suberogorgia suberosa*, Ridley, Zool. Coll. H.M.S. "Alert," p. 349.

A small specimen of this species was taken in a dredging made off the Admiralty Islands at a depth of between 16 and 25 fathoms. The geographical distribution of this species is interesting. Pallas and Esper give the coasts of Western Africa and the West Indies as the localities known to them; Studer found it in the Mermaid Straits, Dampier Archipelago, and in North-west Australia (Indian Ocean); Dr. Copping (*vide*

Ridley) found it at Port Denison, Queensland; Alert and West Islands, Torres Strait (Pacific Ocean). The present record extends its distribution into the Pacific Ocean.

It is evidently a shallow-water form, with a range of from 5 to 50 fathoms in depth.

*Habitat*.—Off the Admiralty Islands; depth, 16 to 25 fathoms.

## 2. *Suberogorgia verriculata* (Esper).

*Gorgonia reticulata*, Ellis and Solander (?), Nat. Hist. Zooph., pl. 17.

*Gorgonia verriculata*, Esper, Die Pflanzenthier, t. xxxv. p. 124.

*Rhipidigorgia verriculata*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 176.

*Sclerogorgia suberosa*, Kölliker, Icones Histiológicae, Abth. ii.

*Rhipidella verticillata*, Gray, Ann. and Mag. Nat. Hist., ser. 4, vol. v. p. 407.

Portions of a specimen of this species are in the collection from Japan.

Esper, who was indebted to "Garnisonprediger Chemnitz" for the example he has figured, thinks it came from the West Indies; Studer found it on the north-west coast of Australia. Dr. Gray (*loc. cit.*) strangely misunderstands this species.

*Habitat*.—Station 232, *Hyalonema*-ground, off Japan; depth, 345 fathoms; bottom, green mud.

## 3. *Suberogorgia köllikeri*, n. sp. (Pl. XL. fig. 2).

Some large pieces of an Alcyonarian occur in the collection which, from their sclerogorgic central axis, we refer to this genus; they form part of an extraordinarily fertile gathering made on the site of the "*Hyalonema*-ground" at Japan.

The colony, so far as can be judged from the fragments, is branched, one of the pieces measures 165 mm. in height, with a diameter of 3 mm. at its base; the branches tapering to an average diameter of 2 mm. The main branches proceed from the stem in the one plane; but a secondary series of twigs grows forwards, and then grows up parallel with, but at some distance from the parent stem; but these secondary branches again give origin to smaller branches, which proceed in the same plane. There is no trace of any anastomosis.

The polyps arise from all parts of the stem and its branches with the exception of a narrow, often wavy portion on either side of the cylindrical axis, which is occupied by the nutrient canals; they are completely retractile, within well-marked verrucae, which are from 2 to 3 mm. in diameter.

The sclerogorgic central axis is cylindrical, it is somewhat dense, and is composed of a series of interlacing and agglutinated calcareous spindle-shaped spicules, which seem to form a denser mesh or network than that met with in either of the other two species. The outer portion is marked on opposite sides by two shallow winding grooves for the nutrient canals.

The cœnenchyma is thin, and is densely packed with an outer layer of spiny or warty spindles; some of these spicules lose the elongated spindle shape, becoming almost orbicular. Under this layer and extending up into the verrucæ, smaller spiny spindles are met with, some of which show a tendency to assume the double spindle form, which is so characteristic of the other species of this genus. The eight-rayed edges of the verrucæ contain also small narrow spiny spindles. A colleret of smooth and spiny acerate spicules surrounds the bases of the tentacles, and a few minute spicules are to be found on the outer portion of each tentacle, which on the withdrawal of the polyp form an opercular covering.

The colour of the colony in spirits is a yellowish-brown.

The spicules measure as follows:—The larger warty spindles 0.4–0.12; 0.4–0.1; 0.4–0.06; 0.38–0.1; 0.28–0.1; 0.26–0.1 mm. The smaller spindles 0.2–0.06; 0.18–0.06; 0.12–0.04; 0.1–0.02 mm; those of the tentacles 0.2–0.02; 0.1–0.02 mm.

This species has the largest and most prominent polyps of any of the known species.

*Habitat*.—Along with *Suberogorgia verriculata* (Esper) at Station 232, *Hyalonema*-ground, off Japan; depth, 345 fathoms; bottom, green mud.

#### Genus *Keroeides*, n. gen.

Axis sclerogorgic, *i.e.*, consisting of a central core which is made up of bundles of long, narrow, smooth, spindle-shaped spicules, agglutinated and partially intercalated with one another; the nutrient canals surround this central core; the cœnenchyma being moderate and friable.

The colony consists of a much branched stem; the polyps are placed on either side of the stem and branches, on slightly prominent verrucæ, which from their bilateral arrangement give a somewhat flattened appearance to the branches; the space free of polyps forms a well-marked groove running down the centre of the stem and its branches.

The cœnenchyma consists of large, massive spicules, mostly of warty spindles, which appear covered with a somewhat dense spiculiferous capsule. The verruciform prominences contain smaller warty spindles; while minute spiny acerate spicules are to be found in the tentacles of the polyps.

The polyps are retractile, the edges of the verrucæ folding in over them forming an oval eight-rayed star.

Duchassaing and Michelotti describe under the name of *Acis nutans*, n. sp., a form taken at Santa Cruz, which judging from their description and still more from the apparently well executed figures, cannot belong to the genus *Acis*. While the type specimen of *Acis guadalupensis*, Duchassaing and Michelotti, still exists, very unfortunately there is no trace of their *Acis nutans*.

*Acis nutans* is described as follows, "Polyparium in plano ramosum, ramis gracilibus crebre ramosis nec anastomosantibus, subalternis, irregulariter digestis; statura 5-7 pollicaris; ramuli cellulis prominulis subnodosis evanescentibus; axis fuscus, cortex miniaceus, cellularum ore atro-nigrescente." It is also added that the large spicules, which form the "bark," seem to be covered with "une couche animale très-mince et très fugace."

The enlarged figure given by Duchassaing and Michelotti of the polyps of this species resembles in a very striking manner the same portions of the species we now describe, while the phenomena of the animal matter covering the cœnenchyma, and the red coral colour are in common with our species. We further think we can recognise a sclerogorgic form of central axis in the drawing of the colony of *Acis nutans*. While, therefore, there can be no doubt as to the necessity of a new genus, to receive the species taken during the Challenger Expedition, some doubt must remain as to whether it may not be the same species as the form from Santa Cruz. Fresh specimens from this island would enable the question to be determined.

*Keroeides koreni*, n. sp. (Pl. XL. fig. 3).

No perfect colony was found, but from a large tin filled with a tangled mass of Alcyonarians, from Station 232, Japan, several broken fragments of this pretty new form were taken.

Judging from the broken fragments, the colony was attached, with stem erect, and branches proceeding at nearly right angles to the main axis, and from these smaller branches again proceeded after the same fashion, these possibly slightly pendulous. The polyps are found over the main stem and branches, but with a marked tendency towards a bilateral arrangement; on some of the smaller branches the lateral arrangement of the polyps with a central groove between them is very clearly seen.

The polyps are placed within somewhat flattened verrucæ, the twigs appear to terminate in two polyps, of which one is somewhat in advance of the other; there appears to be a slight tendency to a pendulous habit in the terminal twigs.

The colour in spirits is a bright red, like wax coloured with vermilion, which has suggested the generic title.

The central axis of this species is composed of a dense bundle of elongated calcareous spicules, strongly resembling in contour the prosenchymatous cells in the bundle-tissue of plants, they are smooth spindles, pointed at both ends, and slightly inflated in the middle, differing but little from those figured by Kölliker, as found in "*Sclerogorgia verriculata*," but much larger, measuring 0.40-0.05; 0.36-0.04; 0.34-0.04; 0.28-0.05; while to some extent they form a network, yet they would appear more generally to be agglutinated to one another, side by side, slightly intercalating with each other by their acute ends,

so that on fracture of the mass the broken ends of the spicules form an almost level surface. When all the calcareous material is removed, there is very little alteration in the bulk of the axis, and a very slight alteration in the shape of the individual spicules.

The cœnenchyma is thin, with very large warty spindle-shaped spicules forming a dense pavement over the stem and branches; these get smaller at the base of the verrucæ, where they envelope the eight-rayed star projection, which covers over the completely retracted polyps.

The verrucæ are but little elevated; a coronet of minute acerate spicules surrounds the bases of the tentacles, and these are also to be met with in the tentacles.

The two largest of the fragments measure, respectively, 80 mm. in length by 7 mm. in breadth; 60 mm. long by 8 mm. broad. The verrucæ measure from 3 to 5 mm. in breadth.

When a fragment is dried, the pink colour slightly fades, owing to a white cuticle-like layer, which seems to envelop the whole of the spicules of the cœnenchyma, and which becomes opaque on drying; it is just possible that this may have given origin to the statement of Duchassaing and Michelotti already referred to.

The spicules measure as follows:—the large red spindles in the cœnenchyma, 2·4–0·32; 2·1–0·3; 1·84–0·3; 1·60–0·6; 1·08–0·4 mm. The flattish disc-like forms 0·4–0·2; 0·26–0·406; 0·5–0·3 mm. The small spindles 0·3–0·1; 0·28–0·04; 0·24–0·04; 0·20–0·04 mm. The spicules of the polyp and tentacles 0·2–0·06; 0·2–0·04; 0·1–0·02; 0·08–0·02 mm.

*Habitat*.—Station 232, *Hyalonema*-ground, off Japan; depth, 345 fathoms.

### Family III. MELITODIDÆ.

*Isidina* (pars), Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 192, 1857.

*Melithæaceæ* (pars), Kölliker, Icones Histiologicæ, p. 142, 1865.

*Melithæadæ*; *Mopselladæ*; *Trinelladæ*, Gray, Cat. Lithophytes, pp. 3–13, 1870.

*Elliselladæ* (pars), Gray, Cat. Lithophytes, p. 24, 1870.

*Melithæaceæ*, Klunzinger, Die Korallenthier des rothen Meeres, p. 57, 1877.

*Melithæidæ*, Ridley, Zool. Coll. H.M.S. "Alert," p. 356, 1884.

*Trinellidæ*, Ridley, Ann. and Mag. Nat. Hist., ser. 5, vol. x. p. 130, 1882.

The name *Melitæa* having been used for a genus of Insects by Fabricius in 1808, four years before it was employed by Lamouroux, it was replaced by Verrill in 1865 by the name *Melitodes*, and as the family name "*Melithæidæ*" has been used in so many various senses, it seems advisable to adopt the name suggested by Verrill also for the family.

The family, as understood by us, embraces those forms of Alcyonaria in which the axis consists of an alternating series of hard and soft joints; the intimate structure of both of these

portions being in all essentials of the same type—that is of a sclerogorgic basis. In the harder portions (internodes) the separate elongated spicules are in the young state of the axis very clearly seen; the calcareous particles increase at the expense of the horny ones; with a result that the internode becomes of a stony hardness, and in some cases, especially in *Parisis*, almost homogeneously calcareous. In the softer portions (nodes) the sclerogorgic state is more permanent, as the spicules retain a great deal of their horny framework, and though to a large extent inosculated with each other, never altogether lose their individuality. In some forms the nodal portions, as Lamarck long ago pointed out, are much more swollen (nodiform) than the internodal portions; but this is not always the case, as in *Parisis* the diameter of these two portions is more or less uniform, and in very old stems of some species of *Mopsella* and *Melitodes* the very reverse, as is well known, is to be found.

The branches arise either from the nodal or internodal regions; in some exceptional cases even in the same colony from both.

While there is no doubt a resemblance to the family of the *Isidæ*, yet we have been unable to detect in any of the species belonging to the *Isidæ* the appearance of any sclerogorgic tissue, and we therefore think it better to keep the *Melitodidæ* in close sequence to the *Sclerogorgidæ*.

In some species an apparent dimorphism occurs, as has already been pointed out by Ridley. So far as our investigations on a very limited material have gone—the larger polyps have always been found full of ova—and we have found no such difference in structure as would point to the existence of auto- and siphonozoids, but we think it possible that, as is well seen among the autozoids of some of the *Dasygorgidæ*, the difference in size is solely the result of an effective fertilization.

#### Genus *Melitodes*, Verrill.

*Isis* (in part), Linnæus, Ellis, Esper.

*Melithæa* (in part), Lamouroux (1812) [preoccupied *Melithæa*, Fabricius, 1808].

“ ” Lamarck, Mém. Mus. Hist. Nat. t. i. p. 410, 1815.

“ ” Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 199.

*Melitodes*, Verrill, Bull. Mus. Comp. Zool., vol. i. p. 38, 1865.

*Melithæa* (in part), Köl liker, Icones Histiologicæ, Abth. i. p. 142.

*Anicella* (?), Gray, Cat. Lithophytes, p. 9.

*Melitella*, Gray, Proc. Zool. Soc. Lond., p. 485, 1859.

*Acabaria*, Gray, Proc. Zool. Soc. Lond., p. 484, 1859.

*Psilacabaria*, Ridley, Zool. Coll. H.M.S. “Alert,” p. 363, 1884.

While agreeing with Verrill (*loc. cit.*) in taking *Isis dichotoma*, Lamarck, as the type of this genus, and including in it all those species in which the spicules of the cœenchyma are warty or kneed spindles; and in which “Blattkeulen” are not present;

yet it must be borne in mind that there would appear to be no very well marked distinctions between the warty spindles called "Stachelkeulen" by Köl liker and those spindles with foliaceous tops, called by him "Blattkeulen." Sometimes the flattened terminal crown of excrescences of a Stachelkeulen will be found to assume almost an identity of shape with those of some of the attenuated "folia" of some Blattkeulen.

It must also be remembered that there has been a great deal of confusion as to the limits of the genera in this family, and even, as has already been pointed out, a misunderstanding as to its leading characteristics, which date from the days of Linnæus, and which, from the impossibility of our obtaining many of the type species of Esper and Lamarck, we cannot hope to have in every respect cleared up.

An examination of the species in the museums of Erlangen, Paris, and London, will be needed ere many points in doubt can be cleared up.

That the presence of a dense layer of "Blattkeulen" in the cœnenchyma of such species as *Mopsella retifera* (Lamarck), *Mopsella coccinea* (Ellis), *Mopsella elongata*, Gray,<sup>1</sup> will easily distinguish them and allied species from most of those here referred to *Melitodes* will not be contradicted. While this feature was already pointed out by Köl liker, it assuredly never entered into Dr. Gray's conception of the genus *Mopsella*.

The distinctions also between the genera *Acabaria*, Gray, and *Psilacabaria*, Ridley, seem not to be very well marked, but the time has not come for accurate limitation of the various species, and in the meanwhile the following may stand as an emended diagnosis of Verrill's emended genus *Melitodes*.

Colony adherent, branched; branches very frequently in the one plane, but sometimes ramifying in several planes. The main axis and the branches consist of soft (nodal) and hard (internodal) joints, alternating. Branches proceeding (with few exceptions) from the nodes, more or less freely anastomosing. Both nodes and internodes are formed by sclerogorgic tissues, which become dense and more calcareous than horny in the internodes, and in the nodes remains more horny than calcareous, while the spicules are much less consolidated together. The longitudinal canals penetrate both series of joints. The cœnenchyma varies much in denseness and contains an outer layer of spiny spindle-shaped spicules (Stachelkeule); half-sided spiny spicules, these latter often very well developed; perhaps in the species of no genus is there to be found a greater diversity in the form of the spicules, and owing to the manner in which they interlock with one another, it requires some care to determine their perfect shapes. In the neighbourhood of the verrucæ spiny and bent spicules with spiny apices occur. The polyps are retractile within more or less prominent verrucæ.

<sup>1</sup> This is not *Mopsella elongata*, Verrill.



*Melitodes dichotoma* (Pallas) (Pl. XL. figs. 4, 5).*Isis dichotoma*, Pallas, Elench. Zooph., p. 229.

,, ,, Esper, Die Pflanzenthier, p. 43 ; Fortsetzung., p. 6, Tab. vi., xi. figs. 4, 5.

,, ,, Lamarck, Mém. Mus. Hist. Nat., t. i. p. 415.

*Mopsea dichotoma*, Kölliker, Icones Histologicæ, p. 142.*Non Mopsella dichotoma*, Gray, Cat. Lithophytes, p. 10 ; Proc. Zool. Soc. Lond., 1857, p. 284.*Nec Mopsea dichotoma*, Milne-Edwards (*pars*) Hist. Nat. des Coralliaires, p. 197.

The colony is attached ; it is more or less fan-shaped in form though sometimes it branches irregularly, assuming a bush-like shape. It is from 130 to 190 mm. in height, but varies much in width and depth. The basal attachment is broad, reptant, sometimes stoloniferous, and bearing polyps, from which apparently new vertical colonies arise.

The branches show a tendency to originate in the one plane, but in some cases the branches arise in an irregular manner ; the branches shortly after their origin divide into twos, and this with a certain regularity. The anastomosis varies very much ; in some specimens there is no anastomosis between the branches of a colony, but a feeble anastomosis between the branches of a neighbouring colony. In others there is an irregular anastomosis between some few of the branches, and this in even different planes, but no true mesh system is formed, and the extremities of the branches are free for a considerable distance below their terminal points. The main axis and branches, when clothed with the polyps and cœnenchyma, are cylindrical, and show no distinction between the nodes and internodes. The axis has an average basal diameter of 4 mm., diminishing to one of 1·5 to 1 mm. for the twigs.

When deprived of cœnenchyma, the internodes are found to vary in length, being from 4 to 6 mm. in the basal portion of the colony, and from 6 to 8 mm. in the terminal portions. The nodes are not prominent, being in fresh specimens of the same diameter as the internodes, *i.e.*, about 2 mm. towards the base and 0·5 mm. beneath the terminal internodes.

The polyps are crowded irregularly on the front and sides of the branches ; while on the back of the colony, except at the extreme tips, they are absent, and here the cœnenchyma is striately marked. The polyps are lodged in well-developed verrucæ, which measure about 1·25 mm. in diameter, and 1 mm. in height. The polyps are retractile within the verrucæ.

The cœnenchyma is thick and dense, it has a layer of large, half-sided, spiny spindles, the spines on the one side largely developed, and short four-rayed spicules. Other spicules of the cœnenchyma present the forms of warty spindles (*Stachelkeule* of Kölliker), or feebly developed *blattkeule*, four-rayed stellate forms (*Vierling* of Kölliker), spiny one-sided spindles, bent spindles, and of warty double spindles. These spicules also cover the verrucæ. The polyp spindles are straight and bent spiny spindles.

The spicules, which are of a light red colour, measure :—the half-sided spiny spindles

0.1–0.8; 0.1–0.6; 0.12–0.1 mm. The warty spindles 0.26–0.12; 0.22–0.1; 0.12–0.1 mm. The bent spinose spicules 0.3–0.1; 0.28–0.06; 0.2–0.1; 0.26–0.1; 0.18–0.1 mm. The double stars 0.1–0.1; 0.08–0.04; 0.01–0.06 mm. The four-rayed forms 0.18–0.16; 0.14–0.1 mm. The simple spindles 0.34–0.8; 0.36–0.2 mm. The irregular branching spicules are about 0.3 mm. in length, with a width varying from 0.1–0.15 mm. The small polyp spicules 0.12–0.4; 0.06–0.02 mm.

Colour.—What we take to be the type form is of a bright brick-red. The internodes when bare are of a bright pink, while the nodes are of a brown colour.

In the same collection, in several cases growing side by side, and in one instance anastomosing with the form above described, there occur a yellow-coloured variety and one with a slightly pink hue. Nothing in the external form or structure, except that in the yellow variety the anastomoses are more frequent and the polyps perhaps more crowded, would call for special observation, but the spicules differ somewhat in form. In Var. A. the Stachelkeule almost assume the form of Blattkeule, the spiny spindles are often quite blunt at both ends, and the half-sided spiny spindles are large, often with quasi folia at the tips. In Var. B. the Stachelkeule are well developed, and there are present, chiefly in the inner layer of the cœnenchyma, a large number of the irregularly branching spindles.

*Habitat*.—Torres Strait.

*Melitodes rugosa*, n. sp. (Pl. XL. fig. 6).

The colony is branched, about 80 mm. in height and 60 mm. in the widest stretch of the branches; the branches are not all in the one plane and there is no apparent anastomosis. The base is attached to a small "frond" of a *Flustra* by a disc-like plate, which is bifid, embracing the edge of the frond between the two folds; it is 3 mm. in its widest diameter. The main axis at a height of 17 mm. branches, the first branch proceeding from an internode. The first internode is 25 mm., the second is 11 mm. in length. The stem at its base is 1.25 mm. in diameter. The internodes are long, sometimes irregular in form, wavy in outline, and of a pink colour when stript. The nodes are triangular in shape, 2.5 mm. at base and the same in height.

The polyps are scattered irregularly over the stem and its branches. They are retractile, within verrucæ, but these are not prominent, though sufficiently so to give an undulating appearance to the branches; they are about 1 mm. in diameter at their bases.

The cœnenchyma is somewhat dense and the spiny spindles projecting in part from its surface gives this a roughened rugose appearance. Some of the Stachelkeule approach in form very nearly to Blattkeule.

The colour in spirit is a greyish-white with a few specks of yellow, owing to the

yellow-coloured spicules of the polyps and of some few spicules of the same colour which are scattered in the outer surface of the cœnenchyma.

The spicules measure :—the Stachelkeule or Blattkeule 0·22–0·1; 0·2–0·06; 0·19–0·06; 0·1–0·06; 0·1–0·08 mm. The one-sided spiny spindles 0·14–0·08; 0·2–0·1 mm. The bent spiny spindles 0·26–0·06; 0·16–0·08 mm. The straight warty spindles 0·1–0·08; 0·1–0·04 mm. The polyp spicules measure 0·1–0·04; 0·08–0·02 mm.

*Habitat*.—Station 162, off East Moncœur Island, Bass Strait; depth, 38 to 40 fathoms.

*Melitodes rubeola*, n. sp. (Pl. XL. fig. 7).

A large mass torn from its basal attachment was found at Station 190. It forms portion of a colony about 175 mm. in height by nearly 200 mm. in width. The colony is extensively branched, but these branches are not always in the one plane, and they form by a series of outgrowths and anastomoses a number of fan-shaped nets united to one another by several cross anastomoses, thus presenting the appearance of a series of parallel fans. Towards the basal portion anastomoses form a net with somewhat close meshes; these, however, become somewhat more elongated towards the circumference.

The stoutest of the basal internodes are about 2·5 mm. in diameter, but become of extreme fineness towards the terminal twigs; in length they vary from 4 to 13 mm. The nodes are conspicuous, 2 mm. in diameter. When deprived of cœnenchyma, the internodes are smooth, cylindrical, and white; the nodes are of a bright pink colour; the internodes are slightly grooved towards the base of the axis.

The polyps are placed on the branches with a marked bilateral tendency, but sometimes are alternate and in spires. They are retractile within well-developed verrucæ, which latter have elevated edges and are 1 mm. in diameter and 0·5 mm. in height.

The cœnenchyma is rough, with large, very spinous, spindle-shaped spicules (Stachelkeule).

The colour of this fine species in spirits is white, with bright pink nodes. These pink nodes are not so conspicuous in dried specimens. It is not related to *Mopsea bicolor*, Kolliker.

The spicules measure :—the Stachelkeule 0·18–0·07; 0·18–0·06; 0·14–0·06; 0·12–0·04 mm. The one-sided spiny spindles 0·12–0·08; 0·1–0·08; 0·12–0·1 mm. In some of the spindles the protuberances from the one side of the spindles are continued out into a long blunt or pointed arm; these measure, length and greatest breadth, 0·2–0·06; 0·2–0·04; 0·16–0·04; 0·1–0·06 mm. The simple spiny and bent spicules are 0·3–0·04; 0·1–0·02; 0·2–0·1; 0·24–0·1; 0·26–0·1 mm.

*Habitat*.—Station 190, Arafura Sea; depth, 49 fathoms.

*Melitodes rubeola*, n. sp., var.

The colony is branched, the branches freely anastomosing. An average specimen measures 130 mm. in height and about 200 mm. in greatest breadth. The branches are all given off in the one plane, so that the whole colony presents the form of a broad fan; the branches arise from a short simple axis, which is attached and is about 4 mm. in diameter. A second small colony arising alongside speedily anastomoses with it, in the same plane; while a third colony of about the same dimensions, but arising at a short distance though parallel to the first, soon by a series of cross anastomoses, becomes connected therewith; forming, as it were, a fan within a fan.

The meshes are extremely irregular in outline, and the branches end in a series of free bifurcations; about 0.5 mm. in diameter.

The polyps are crowded irregularly over the branches; they are retractile within verrucæ, which are about 1 mm. in diameter, but these do not project much above the surface of the cœnenchyma. When retracting, the tentacles fold in first and then the body of the polyp is withdrawn; a coronet of bent spindle-shaped spicules surrounds the bases of the tentacles, and a few straight spiny spindles strengthen the dorsal portions of the tentacles.

The cœnenchyma is dense and the surface has a roughened, glistening appearance from being studded over with masses of Stachelkeule and half-sided spiny spindles; the internodes when stript are pinkish and grooved.

The spicules measure:—The Stachelkeule are somewhat smaller and less spiny than in the type, measuring 0.14–0.04; 0.16–0.04; 0.1–0.04 mm. The one-sided spiny spindles when seen in shortest axis are curiously like Blattkeule, but the extremities are spiny, not blunt; they measure 0.06–0.04; 0.08–0.06 mm. The double crosses measure 0.06–0.04; 0.08–0.04 mm. The curved and bent spiny spindles, which are chiefly of a yellow colour, are 0.3–0.02; 0.26–0.04; 0.2–0.04; 0.22–0.04; 0.16–0.04 mm. The flat angular spicules found in the verrucæ are 0.12–0.02 mm. The straight warty spindles are 0.14–0.04 mm., and there are a few spindles with only a central knot of spines measuring 0.1–0.02 mm.

The colour in spirits is a grayish-white for the internodes; and a bright pink for the nodes. The polyps are of a yellowish hue, owing to the presence of yellow-coloured spicules; when dried the colour is a pinkish-yellow with yellow polyps.

*Habitat*.—Station 190, Arafura Sea; depth, 49 fathoms.

*Melitodes philippinensis*, n. sp. (Pl. XL. fig. 8).

Portions of several colonies of this species are in the collection from the Philippines. It seems to be variable in its colouring.

The colony is branched in the one plane, fan-shaped. The largest specimen measures about 150 mm. in height by about 100 mm. across the widest part. An anastomosis between both nodes and internodes is frequent and occurs from the basal portion of the colony to the very ends of the branches. In the basal portion of the main axis the nodes and internodes become confluent with those of the parallel branches, forming a massive stump-like base. In the upper meshes the internodes vary from 4 to 8 mm. in length, with an average diameter of 1 mm. The nodes are well marked, slightly more prominent on the back of the colony, 1·5 mm. in diameter.

The polyps are arranged on the sides of the branches, but while sometimes assuming a quite bilateral arrangement, at other times they are found in clusters, extending over the front of the branches, and on the tips of the branches they are even found all round. They are retractile, within distinct verrucæ, which are from 0·5 to 1 mm. in diameter; sometimes the verrucæ project but little beyond the surface of the cœnenchyma. In one colony besides the ordinary sized polyps, others are to be found the verrucæ of which measure 1·5 mm. in diameter and 1·25 mm. in height; those examined were found to be full of ova. The cœnenchyma is moderately thick and rough with spicules.

The colour of the colony varies; one being of a light yellow colour with the polyps of a vermilion red; in another the yellow is of a brighter hue and the verrucæ are pink; and in a third, of which there are but a few fragments, the colour is of a pure white with pink verrucæ.

The spicules measure:—the club-like spindles 0·18–0·04; 0·16–0·06 mm. The bent warty spindles 0·2–0·08; 0·2–0·06; 0·16–0·08 mm. The Stachelkeule measure 0·1–0·04; 0·1–0·06; 0·14–0·04 mm. The one-sided spiny spindles 0·06–0·06 mm. Four-rayed forms 0·12–0·06 mm. The curved spiny spindles on the polyps 0·2–0·02; 0·16–0·02; 0·14–0·04 mm. The irregularly branched spindles 0·14–0·1 mm. in broadest, and 0·02 mm. in narrowest diameter; the double crosses 0·06–0·04 mm.

*Habitat*.—Reefs, Samboangan; February 1, 1875.

*Melitodes sinuata*, n. sp. (Pl. XL. fig. 9).

A small but possibly nearly complete colony of this species is in the collection; it wants the basal attachment and is also somewhat frayed away towards the terminal branches. It is fan-shaped and measures 90 mm. in height and about the same in greatest width. The branches freely anastomose, giving rise to a complicated series of meshes, into which very short lateral branches protrude. The nodes are large, measuring 3·5 by 3 mm. in the basal portion of the colony, and 2 by 2 mm. in the terminal twigs. The internodes vary greatly in length, being from 4 to 10 mm. towards the circumference, and not more than 2 mm. at its basal portion. The basal internodes measure 2·5 mm. in diameter, the terminal ones 1 mm. When denuded of cœnenchyma the basal

internodes are seen to be white, cylindrical, and deeply and spirally grooved, they are of a stony hardness; this grooving is partly visible through the cœnenchyma. The terminal internodes are horny, yellow, often waved, not very calcareous, but decidedly sclerogorgic.

The polyps are placed on the sides of the branches; they are completely retractile within the cœnenchyma, being indeed when completely withdrawn sunk below its level, and thus not presenting the slightest trace of verrucæ. The dorsal and front portions of the branches are free from polyps, which sometimes form a single row on the sides of the branches, but occasionally they occur in clusters.

The cœnenchyma is thin and friable, with an outer layer of large short spiny spindles; the spicules around the polyp openings are long spiny spindles.

Colour a dirty yellow, polyp openings pink.

The spicules measure:—the Stachelkeule 0.18–0.08 at top and 0.02 mm. at bottom of spicule, 0.12–0.04; a few like Blattkeule, but very small, are found, 0.04–0.04 mm. The bent spiny spindles measure 0.2–0.06; 0.2–0.02 mm. The double crosses 0.2–0.06; 0.06–0.04; 0.04–0.04 mm.

*Habitat*.—Reefs, Samboangan, Philippines.

*Melitodes nodosa*, n. sp. (Pl. XL. fig. 10).

Fragments of several colonies, dredged at Japan and off the New Hebrides, are in the collection; they appear to be distinct enough to merit description.

The colony is attached by an irregular calcareous basal disc, and may have been about 130 mm. in height and from 60 to 80 mm. in diameter. The branches arise all in the one plane; the internodes vary from 5 to 10 mm. in length, the shortest being nearest the base, where the diameter is 2 mm., they are cylindrical and slightly grooved. The nodes are prominent, the larger being 3.5 mm. high by 2.5 mm. broad. The terminal twigs are slender and not more than 0.5 mm. in diameter. It is noteworthy that some of the branches are given off from the internodes.

The branches only anastomose very feebly, so as to form but a few very wide meshes.

The polyps are clustered all over the front portion of the branches; sometimes even occurring on the nodes, but the back portion of the colony is almost destitute of polyps. This arrangement of the polyps is not so well marked on the terminal portions of the branches, where the polyps are to be found all round the axis. The polyps are retractile, within well-marked verrucæ, of from 0.75 to 1 mm. in diameter.

The general colour of the colony is a reddish-brown; the nodes being of a darker hue. Deprived of its cœnenchyma and polyps, the colour of the axis is a yellowish-red. The polyps are of a yellow colour.

The spicules of the cœnenchyma are irregular curved spindles with long blunt

spines, 0.24–0.06 ; 0.22–0.08 ; 0.2–0.06 ; 0.18–0.08 ; 0.16–0.06 mm. Irregular branched spicule 0.18–0.6 ; 0.12–0.1 mm. Bent spiny spindles 0.24–0.06 mm. Four-rayed forms measure 0.1–0.1 mm., and in the polyp there are double crosses 0.1–0.04 mm.

*Habitat*.—Station 177, off the New Hebrides ; depth, 60 to 120 fathoms.

Station 232, *Hyalonema*-ground, Japan ; depth, 345 fathoms.

*Melitodes lævis*, n. sp. (Pl. XL. fig. 11).

This species is represented by a small colony broken away from its basal attachment, it is about 70 mm. in height, the whole colony is fan-shaped, about 50 mm. in its widest diameter. It branches frequently and irregularly ; and the branches anastomose freely. The branches are arranged in three parallel fan-shaped masses, with a free anastomosis between each parallel portion. The basal internodes are 2 mm. in diameter, gradually diminishing in diameter to 3 mm. beneath the terminal free extremities, and are often twisted. In length they vary from 5, 6, and 7 mm. in the basal internodes, to a length of 8 and 9 mm. for the terminal internodes. The nodes are prominent, 3 mm. in width towards the basal portion of the colony, and 2 mm. towards its apex. When deprived of their cœnenchyma, the older internodes are seen to be cylindrical in outline and they are distinctly grooved ; they are of a faint pink colour.

The polyps are scattered over the front of the stem and its branches, but with a very well-marked tendency to a bilateral arrangement ; which is indeed clearly to be seen on the terminal twigs ; they are from 1 to 1.5 mm. distant from each other. They are retractile within but slightly elevated verrucæ, which latter are from 0.75 to 1 mm. in diameter.

The cœnenchyma is very thin. The spicules forming a nearly smooth surface, through which the grooving of the internodes is seen.

The spicules are Stachelkeule, which are frequently found with much longer spines on one side than the other ; these measure 0.24–0.06 at apex and 0.02 at base, 0.18–0.04 ; 0.04 mm. The slightly bent spiny spindles measure 0.22–0.02 ; 0.16–0.02 ; 0.24–0.06 mm. The one-sided spiny spicules measure 0.1–0.06 ; 0.06–0.04 ; 0.08–0.04 mm. Some small warty spicules measure 0.08–0.02 mm., and some stellate forms 0.12–0.06 mm.

Colour a dull grey-white, with polyp tentacle spicules yellow.

*Habitat*.—Amboina ; depth, 15 to 25 fathoms.

*Melitodes esperi*, n. sp. (Pl. XL. fig. 12).

The colony is branched, fan-shaped, about 140 mm. in height by 150 mm. across its extreme outline, the branches being all in the one plane ; the main axis is oval, with a basal diameter of 10 mm. at its broadest and 5 mm. at its narrowest. The average

length of the internodes, including the cœnenchyma, is 8 mm., with a diameter of 1 mm.; while the nodes measure 2·5 by 3 mm. The branching seems to consist of a division of each of the twigs, at the nodal regions, into two portions, which then proceed upwards in a quasi-parallel manner; the anastomosis taking place by a series of short lateral twigs, about 3 mm. in length, which stretch from one node to another.

The internodes when stripped of cœnenchyma are found to be broad, flattened, or broadly oval on section; in the older portions of the colony this is so markedly the case, that while the broad diameter is 1·5 mm., the short diameter is only 0·575 mm., bevelling off to nothing at the edges; they are of a bright pink.

The polyps are scattered all over the branches, with shallow verrucæ; they are somewhat lateral on the terminal portions, and they are not so numerous and indeed are even absent from the dorsal aspect of the colony. The verrucæ are from 0·5 to 1 mm. in height.

The cœnenchyma is thick; the large spiny spindle-shaped spicules forming a dense layer.

The spicules measure:—the Stachelkeule, which have sometimes rather flattened heads, 0·24–0·06; 0·2–0·1; 0·16–0·06 mm. The one-sided spiny spindles 0·1–0·06; 0·1–0·04 mm. The warty bent spindles measure 0·24–0·06 mm., these are mostly in the cœnenchyma. In the verrucæ, the double crosses measure 0·01–0·04; 0·08–0·06; 0·06–0·04 mm. At the base of the tentacles, the curved spiny spindles measure 0·3–0·02; 0·24–0·025; 0·22–0·025 mm. A few four-rayed forms are found, measuring 0·04–0·04 mm. in the polyps, where also occur some simple spindles with eight small central knobs, 0·04–0·02 mm.

The colour in spirits is a deep red; the polyps yellow. The colours when dry fade a good deal.

*Habitat*.—Torres Strait.

*Melitodes fragilis*, n. sp. (Pl. XLI. fig. 1).

Some few fragments of this small but interesting species were found in a dredging at Amboina; they were so entangled in the meshes of the tow that it was impossible to obtain a very accurate idea of the appearance of the perfect colony. It was apparently of small size.

The largest fragment is a detached branch of 40 mm. in height and 15 mm. in width; it branches irregularly, but the branches have a tendency to assume the one plane. The branches are twisted; in this fragment there is but one anastomosis, which is between two parallel branches, but in other fragments mesh-like anastomoses occur. The internodes which are often curved and twisted vary greatly in length, measuring 4, 8, and 12 mm. in length; in various fragments the largest are 1·5 mm. in length,



while those of the terminal twigs are scarcely 0.5 mm.; when deprived of cœnenchyma they appear pink and furrowed. The basal nodes are from 2 to 1.5 mm. in width.

The polyps are mostly bilaterally placed, about 1 mm. apart; they are retractile, within but slightly elevated verrucæ of almost 1 mm. in diameter; on one fragment a larger polyp occurs which measures 1.5 mm. in diameter, and 1 mm. in height above the cœnenchyma. The polyps are well-furnished with spicules, there being a basal coronet of bent and curved spiny spicules and the dorsal portion of each tentacle is covered with spiny spindles of a yellow colour.

The cœnenchyma is thin and shows through it the furrowings of the internodes. The outer layer of red warty and spiny spindles gives it a roughened appearance when magnified; underneath this comes a layer of colourless spindles and stellate spicules. Towards the tips of the terminal branches there is a mixture of yellow, red, and white spicules which is very striking.

The general colour of the colony seems to vary from a deep salmon colour to a deep red; the polyps are yellow.

The spicules measure:—those in the cœnenchyma, the warty one-sided spindles 0.22–0.06; 0.18–0.04 mm.; the thick warty slightly curved spindles 0.2–0.1; 0.22–0.08 mm. In the inner layer the stellate forms measure 0.12–0.04 mm., and the short spindles with eight projecting knobs measure 0.08–0.04; 0.08–0.02; 0.06–0.02 mm. The curved spiny spindles of the polyps measure 0.4–0.04; 0.32–0.03; 0.24–0.025; 0.38–0.02 mm.; the long measurements of these are taken across from tip to tip of the curve. The spiny spindles with blunt and sharp ends measure 0.3–0.04; 0.24–0.04; 0.22–0.04 mm.

*Habitat.*—Amboina; depth, 15 to 20 fathoms.

The last four species would be placed by some in *Acabaria*.

#### Genus *Paris*, Verrill.

*Paris*, Verrill, Bull. Mus. Comp. Zool., 1865, p. 37.

„ Gray, Cat. Lithophytes, p. 13.

*Trinella*, Gray, Cat. Lithophytes, p. 12.

*Paris*, Ridley, Ann. and Mag. Nat. Hist., August 1882, p. 130.

Verrill first established this genus for a form from the Sulu Sea, taken during the United States Exploring Expedition. It was diagnosed as follows—“Corallum irregularly branching, nearly in a plane. The axis consists of alternately calcareous and suberous segments, of uniform thickness, traversed by numerous narrow sulcations. The branches originate from the calcareous segments. Cœnenchyma persistent, rather thin, somewhat membranous, with a rough surface. Cells prominent, arranged irregularly on all sides of the branchlets, but often absent on the median surfaces of the larger branches.” Dr. Gray contents himself with copying Verrill’s description but

makes a new genus, *Trinella*, for a form which on examination proves to be but one of Verrill's species overgrown with a *Palythoa* and a Sponge, and establishes the family Trinellidæ for the two genera *Trinella* and *Parisis*. Verrill describes two species—*Parisis fruticosa* from the Sulu Sea, and *Parisis laxa* from Hong Kong.

The rough hispid surface mentioned by Verrill as characteristic of the outer layer of the cœnenchyma is possibly due to the siliceous spicules of a Sponge, for we find in all the specimens in the Challenger collection, when free from parasites, that the spicules form a more or less tessellated pavement, which lies in an even layer over the whole of the cœnenchyma and extends up to the edge of the verrucæ. From the sclerogorgic nature of the nodes and internodes when young, we place this genus here instead of with the Isidæ.

This genus seems to approach *Clathraria*, Gray, in the form of the spicules.

*Parisis fruticosa*, Verrill (Pl. XLI. fig. 2).

*Parisis fruticosa*, Verrill, Bull. Mus. Comp. Zool., vol. i. p. 37, 1865.

„ *mauritiensis*, Ridley, Ann. and Mag. Nat. Hist., ser. 5, vol. x. p. 131, 1882.

*Trinella swinhoei*, Gray, Cat. Lithophytes, p. 12, fig. 4.

This interesting form—the type species of Verrill's genus—was described from a specimen taken in the Sulu Sea. The diagnosis is as follows—“Large, flabelliform; the principal branches arising irregularly along the sides of the trunk, divide and subdivide rapidly into other smaller branches and branchlets, producing a densely ramulous frond. The branches ascend and diverge usually at an angle of about 50°; the branchlets often spread at right angles, and do not coalesce. Papillæ numerous, crowded on the branchlets, elongated, conical. Colour grayish-yellow; axis white; internodes yellowish-brown.”

No measurements are given and the cœnenchyma and spicules are not described; still the species seems to us to be well represented by a form in the collection from the Banda Sea which unfortunately exists only in fragments.

The colony, of which the fragments would seem to represent two separate specimens, are unattached. The largest measures about 130 mm. in height, with a basal diameter of 3.5 mm. It branches irregularly, but all the branches are in the one plane; many of them again branching. There is no anastomosing of the branches. Owing to the lateral arrangement of the polyps the branches have a flattened appearance.

The axis consists of a series of hard calcareous internodes, of from 6 to 10 mm. in length; these are cylindrical, somewhat rough on their surfaces, and markedly grooved. The nodal regions are in the spirit specimens about the same diameter as the internodes, but are not more than from 0.5 to 1 mm. in length; in these latter the sclerogorgic tissue is but feebly calcareous, and it is seen on cross section to assume a radiate form; on the surface it is grooved, like that of the internodes.

The polyps are placed on the sides of the stem and branches, about 2 mm. apart, sometimes they are opposite and sometimes alternate. They are never terminal; when retracted the verrucæ appear as little conical projections, about 0.5 mm. in height. The cœnenchyma is well marked and is filled with large spicules somewhat resembling those of *Isis hippuris*, but more irregular in outline and with more flattened heads; these latter forming a pavement over the stem and branches, and extending up to the base of the polyp bodies.

These spicules measure 0.5–0.34; 0.34–0.3; 0.3–0.2; 0.22–0.16 mm.; some more club-shaped measure 0.1–0.22; 0.16–0.1 mm. Some smaller stellate spicules are to be found in the verrucæ, these measure 0.1–0.12; 0.12–0.1 mm.

The colour of the colony (in spirits) is a yellowish-white or a dirty brown. The nodes are dark and seen through the cœnenchyma.

No portion of the fragments in the collection seems to be quite free from the parasitism of an incrusting Sponge which appears gradually to destroy the colony.

Dr. Gray has made a family Trinellidæ to include his new genus *Trinella* and Verrill's genus *Parisis*, but an examination of a portion of Dr. Gray's species, *Trinella swinhoei*, from Formosa, demonstrates beyond a doubt, as indeed we had guessed from an examination of the very accurate drawings accompanying his description, that this species is only a partially destroyed specimen of *Parisis fruticosa*, overgrown with the Sponge above referred to, and having in addition some species of *Palythoa* incrusting part of it. Dr. Gray's description would also seem to have imposed on Mr. Ridley.<sup>1</sup>

*Habitat*.—Station 192, off the Ki Islands; depth, 140 fathoms.

*Parisis australis*, n. sp. (Pl. XLI. fig. 3).

Two fragments from off Port Jackson are in the collection, and they seem to differ in several respects from any of the hitherto described species; though in some details they resemble *Parisis mauritiensis*, Ridley, and may through it form a link with *Parisis fruticosa*, Verrill. They are, however, unfortunately in a very bad state for description, owing to their being overrun by an incrusting Sponge, the projecting siliceous spicules of which give a roughened appearance to the colony. The larger specimen is about 235 mm. in height.

The colony as represented by the larger specimen is branched, the branches proceeding from but one side of the axis, they are all in the one plane, and most of them are again branched. There is not the slightest trace of any anastomosis of any of the branches.

The internodal regions of the axis at its base measure from 2 to 2.5 mm. in height; towards the extremities of the branches they increase to a length of from 3.5 to 4 mm.

<sup>1</sup> We venture to regard his species from Mauritius as a variety of *Parisis fruticosa*, Verrill.

The greatest basal diameter is 4.5 mm., with one of 1 mm. at the ends of the twigs. The nodal regions are from 0.5 to 1 mm. in height, and equal the internodal regions in diameter.

The polyps are numerous and arranged in an irregular manner over the stem and branches; the verrucæ are only slightly prominent, about 1 mm. in diameter, but it is possible that the sponge-growth in part hides them.

The cœnenchyma is thin, in the older portions allowing the axis to be seen through it.

The massive warty spicules are more elongated than in *Parisia fruticosa*, and measure 0.24–0.16; 0.2–0.1; 0.16–0.12 mm. Some more globular measure 0.2–0.12 mm.

The colour in spirits is of a dirty brown.

*Habitat*.—Station 163B, off Port Jackson; depth, 35 fathoms.

*Parisia minor*, n. sp. (Pl. XLI. fig. 4).

A small fragment of this small species of *Parisia* was found among some débris dredged from the well-known *Hyalonema*-ground at Japan. While future specimens may prove it to be but the terminal portions of a larger form, yet we think there are sufficient differences in its structural details to justify us in making it a new species near to *Parisia laxa*, Verrill.

The fragment preserved is about 80 mm. in height and 40 mm. in breadth; the branches are numerous and irregular in form, but given off in the one plane; there are no anastomoses, though such may possibly be sometimes present as one small descending branch seems to indicate such.

The internodes vary considerably, being from 3 to 7 mm. in length and 1.5 mm. in diameter; the nodes are scarcely perceptible and in the older portions of the axis apparently becoming consolidated; the calcareous internodes are roughened and with several shallow grooves.

The polyps are in two rows, on either sides of the stem and branches; mostly opposite, but sometimes alternate; about 1.5 mm. apart; they are retractile; rather papilliform. Verrucæ with blunt tips; about 1 mm. in height and the same in breadth.

The cœnenchyma is thin, well tessellated with a layer of many-rayed spicules, which are large; they measure 0.3–0.2; 0.32–0.22; 0.26–0.22 mm.; while the irregular spindle-shaped spicules in the verrucæ measure 0.2–0.1; 0.1–0.8 mm.

The colour in spirits is a brownish-white.

*Habitat*.—Station 232, *Hyalonema*-ground, Japan; depth, 345 fathoms.

## Family IV. CORALLIIDÆ.

*Corallidæ*, Gray, Proc. Zool. Soc. Lond., 1857, p. 286.

*Corallinæ*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 201.

*Coralliidæ*, Ridley, Proc. Zool. Soc. Lond., 1882, p. 221.

Following Ridley we include the two genera *Corallium*, Lamk., and *Pleurocorallium*, Gray, in this family. We refer to his memoir (*loc. cit.*) for a detailed account of the various species.

Genus *Corallium*, Lamarck.

*Madrepora (pars)*, Linneus, Syst. Naturæ, ed. x. p. 797, 1757.

*Isis (pars)*, Linneus, Syst. Naturæ, ed. xii. p. 1288.

*Corallium*, Lamarck, Mém. Mus. Hist. Nat., t. i. p. 407, 1815.

„ Lamouroux, Hist. des Polypes flex., p. 443, 1816.

*Corallium rubrum*, Lamarck.

*Madrepora rubra*, Linn., Syst. Nat., ed. x. p. 797, 1757.

*Isis nobilis*, Linn., Syst. Nat., ed. xii. p. 1288.

*Corallium rubrum*, Lamarck, Mém. Mus. Hist. Nat., t. i. p. 407, 1815.

„ *nobile* (Pallas), Ridley, Proc. Zool. Soc. Lond., 1882, p. 221.

Although no specimens of the precious Coral of commerce were found among the specimens submitted to us; yet we read in the Narrative of the Cruise,<sup>1</sup> that “Red, or precious Coral occurs at St. Iago and also at St. Vincent, the fishery being carried on by Italians, &c. . . . Professor Thomson and Mr. Murray dredged over the ground in the steam pinnace during the whole of the 8th August and were very successful. The Coral occurs in from 80 to 120 fathoms, and is dragged for by rough nets and swabs; a duty of a dollar per kilogramme is paid to the Government.”

Studer also records obtaining specimens of Red Coral from the fishermen at Porto Praya, which he determined to belong to this species.

Genus *Pleurocorallium*, Gray, *emend.* Ridley.

*Pleurocorallium*, Gray, Proc. Zool. Soc. Lond., 1867, p. 126; Cat. Lithophytes, &c., p. 23.

*Pleurocorallium*, Gray (*emend.*), Ridley, Proc. Zool. Soc. Lond., 1882, p. 231.

Colony with stem and branches, these latter with lateral pinnæ. The axis oval on transverse section, white or partly red and white. The cœnenchyma with spicules of two kinds—double clubs and many-rayed double stars. Polyps with shallow verrucæ, those of the stem and main branches confined to the anterior surfaces.

<sup>1</sup> Narr. Chall. Exp., vol. i. p. 191.

*Pleurocorallium secundum*, Dana.*Pleurocorallium secundum*, Dana, Zoophytes, p. 641, pl. lx. fig. 1.

,, ,, Ridley, in Narr. Chall. Exp., vol. i. p. 692.

Several dead and variously incrustated fragments of what may have been this species were taken in the Pacific Ocean. They have been already referred to in the Narrative of the Cruise by Mr. Ridley, but are mentioned here to complete the record.

The largest specimen belonged to a well-branched colony and measures 228 mm. in height; with a basal diameter of 22 mm. The branching is irregular but with a tendency to spread in the one plane, the branches are stout, measuring from 10 to 15 mm. in diameter at their junction with the main stem; they are oval on section. There is no trace of any cœnenchyma, the stem and branches are finely striated, but nearly the whole surface is covered over with various forms of Polyzoa, &c. This specimen was obtained off the Ki Islands; it seems destitute of colour throughout.

A second specimen from off Prince Edward Island may be referred also to this species, it is a single branch, about 130 mm. in height, and with a basal diameter of 10 mm.; it is a dead fragment, but retains the beautiful pink colour of the central portion of the axis; the axis is broadly oval, in some places even flattened and channelled.

A third specimen, which like the first has been already recorded by Mr. Ridley, was obtained at Banda; it measures 55 mm. in height, with a basal diameter of 10 mm.

It must be borne in mind, as already mentioned by Mr. Ridley, that owing to the absence of all the soft tissues and free spicules from these specimens, their determination must more or less be a matter of uncertainty; still the weight of evidence seems in favour of referring them all to Dana's species.

*Habitat*.—Banda; depth, 200 fathoms.

Station 192, off the Ki Islands; depth, 140 fathoms.

Station 145A, off Prince Edward Island; depth, 310 fathoms.

*Pleurocorallium johnsoni*, Gray.*Pleurocorallium johnsoni*, Gray, Proc. Zool. Soc. Lond., 1860, p. 393.

,, ,, Ridley, Proc. Zool. Soc. Lond., 1882, p. 223.

No specimens of this species were found in the collection; but in the Narrative of the Cruise, we find<sup>1</sup> that when about 160 miles south-west of Ferro Island (Station 6) "the dredge was lowered at 10 A.M. on the 18th February 1873 with 2200 fathoms of line, and at 5.30 P.M. it was hauled up, and contained some large branches of an Alcyonarian Coral allied to *Corallium*. Some of the larger branches were nearly an inch in diameter. The central portion of the axis was very compact and of a pure white colour, while the surface was glossy black. The whole of the Coral was dead, and appeared to have been

<sup>1</sup> Narr. Chall. Exp., vol. i. pp. 125, 182.

so for a long time, but it is not impossible that it lived at the depth at which it was dredged." Mr. Ridley, who examined specimens of this Coral, thought it was probably to be referred to *Pleurocorallium johnsoni*, Gray, which occurs at Madeira.

Apparently the same species was again met with at Station 85, off the Island of Palma, in 1125 fathoms. It may possibly be a deep-sea form.

## Order II. PENNATULACEA.

The families, genera, and species belonging to this family have been already described by Professor A. von K  lliker.<sup>1</sup>

## Order III. ALCYONACEA.

### Family I. HELIOPORIDÆ, Moseley.

*Helioporida*, Moseley, Phil. Trans., vol. clxvi. p. 91, 1876.

A compact corallum is present, composed of a fibro-crystalline calcareous tissue as in *Madreporaria*. Corallum consisting of an abundant tubular c  nenchyma, and with calyces having an irregular number of lateral ridges resembling septa. Calyces and c  nenchymal tubes closed below by a succession of transverse partitions. Polyyps completely retractile, with tentacles when in retraction introverted. Mouths of the sacs lining the c  nenchymal tubes closed with a layer of soft tissue, but communicating with one another and with the calycular cavities by a system of transverse canals of soft tissue.

We place this family in close connection with the families Nephthyid   and Alcyonid  ; in conformity, as we believe, with the views of Professor Moseley, whose researches on *Heliopora c  rulea* have completely revolutionised our knowledge of the family.

### Genus *Heliopora*, Blainville, *emend.* Moseley.

Colony compact, branching, tissue calcareous as in *Madreporia*. Calyces with from eleven to sixteen plications; eight symmetrically and radially disposed lobes form a covering closing the mouths of the calyces. Polyyps retractile; the colonies probably unisexual.

### *Heliopora c  rulea*, Blainville.

*Heliopora c  rulea*, Blainville, Manuel d'Actinologie, p. 392, pl. lxi. fig. 3.

" " Milne-Edwards, Hist. Nat. des Coralliaires, vol. iii. p. 231.

" " Moseley, Phil. Trans., vol. clxvi. p. 91.

This species has been so well and fully described by Professor Moseley (*loc. cit.*) that it is unnecessary to give further details here, the more so as only a small fragment of

<sup>1</sup> *Vide* Zool. Chall. Exp., vol. i. part ii.

this species has been found by us in the collection. It is not uninteresting to add that in this fragment, which is partly growing over the axis of a Gorgonid, the polyps are nearly all extruded, at least their tentacular crowns in most cases are displayed.

*Habitat*.—Reefs at Samboangan, Mindanao, *fide* Professor Moseley.

Station 186, Cape York; depth, 8 fathoms (? on Reef).

## Family II. NEPHTHYIDÆ.

*Nephtyidæ*, Verr., Proc. Essex Inst., vol. vi., 1869, including *Siphonogorgiaceæ*, Kölliker, Festschrift. z. Feier des fünfundzwanzigjährigen bestehens der physic.-med. Ges. Würzburg, p. 22, 1874.

*Spoggodinæ*, Dana.

*Spoggodidæ*, *Nephtyadæ*, *Lemnaliadæ* (*pars*), Gray.

*Alcyoniens armés*, Milne-Edwards (*pars*), Hist. Nat. des Coralliaires, t. i. p. 127.

*Alcyoninæ capituliferæ* et *Siphonogorgiacæ*, Klunzinger, Korallenthiere des rothen Meeres, Th. 1, p. 10, 1877.

The colonies form upright, branched stems, each consisting of a more or less developed barren trunk, and of branches which ramify very variously and bear the terminal polyps. The polyps are not divided into a calycine and a tentacular portion, so that no complete invagination of the upper tentacle bearing part into a lower gastral cavity can take place, and in repose the tentacles are folded over the oral cavity or the upper portion of the body can be withdrawn. The polyps are continued into long gastral cavities, which, however, do not open into one another but become separated from one another by thin walls. Each gastral cavity diminishes in size downwards, until at length it terminates in a wedge-shaped, blind sac. Only a few are continued, in isolated cases, directly into the main canal.

The trunk and the larger branches are penetrated by sometimes wide and sometimes narrower canals. These canals are separated only by thin walls, sometimes with and sometimes without spicules; they are surrounded on the outside by a thicker external sheath armed with spicules. The large main canals are connected with the long polyp tubes by canals which originate at the base of the polyps. There is also developed, in the partitions which separate the polyp cavities and canals, another system of narrow, capillary "nutrient-canals." From these the young buds arise, between the old ones, which from the commencement of their development possess longer or shorter digestive cavities. In the branches one can usually distinguish four wide canals whose walls are coterminous in the axis of the branch. New polyps, whose narrow tubes appear on transverse section, occur on the outside of the four main tubes, in the spaces between each two, but their boundary walls do not extend as far as the axis. Towards the end of a branch the young polyps constantly increase in number and their digestive cavities become shorter and shorter.



The Nephthyidæ appear to have originated in lowly organised Alcyonidæ, like *Bellonella*, Gray, and *Iphethyrus*, W. Koch, which exhibit an analogous relation of the polyps.

The relationship of the genera *Spongodes* and *Nephthya* was first recognised by Milne-Edwards (*loc. cit.*). He united both genera with *Paralcyonium*, and contrasted them, under the name “Alcyoniens armés,” with the “Alcyoniens nus,” in which latter *Alcyonium* and *Ammothoa* were comprised.

Later on, Verrill (*loc. cit.*) created the family Nephthyidæ for *Nephthya* and *Spongodes*, and for the new genus *Eunephthya*.

Klunzinger (*loc. cit.*) includes these genera, together with *Ammothoa*, under his *Alcyoninæ capituliferæ*. We owe to him at the same time well-defined generic distinctions between the genera *Ammothoa*, *Nephthya*, and *Spongodes*.

Kölliker's subfamily Siphonogorgiaceæ is also to be united with the Nephthyidæ, in that it is connected with *Spongodes* and *Nephthya* through certain transitional forms to be described later on.

Marenzeller's<sup>1</sup> genus *Gersemia* must also be placed here. Koren and Danielssen in their splendid monograph of the Norwegian Alcyonaria<sup>2</sup> describe several species of a new genus, *Duva*, while Danielssen, in the Zoology of the North Sea Expedition,<sup>3</sup> describes numerous species belonging to the following new genera—*Fulla*, *Væringia*, *Barathrobius*, *Gersemiopsis*, and *Drifa*; these would fall into the first division of the Nephthyidæ.

We can divide the family of the Nephthyidæ as above characterised into two sub-families :—

1. *Spongodinæ*, in which the thin walls bounding the canals of the stem and branches are soft and contain few or no spicules. To this subfamily belong the genera :—

<i>Voeringia</i> , Danielssen.	<i>Drifa</i> , Danielssen.
<i>Fulla</i> , Danielssen.	<i>Duva</i> , Koren and Danielssen.
<i>Barathrobius</i> , Danielssen.	<i>Eunephthya</i> , Verrill.
<i>Gersemia</i> , Marenzeller.	<i>Nephthya</i> , Savigny.
<i>Gersemiopsis</i> , Danielssen.	<i>Spongodes</i> , Lesson.

2. *Siphonogorginæ*, in which the divisions between the canals of the stem and branches are rigid and filled with spicules, the canals themselves being relatively narrow. Here belong the genera :—

<i>Paranephthya</i> , n. gen.	<i>Chironephthya</i> , n. gen.
<i>Scleronephthya</i> , n. gen.	<i>Siphonogorgia</i> , Kölliker.

<sup>1</sup> *Denkschr. d. math.-nat. Cl. k. Akad. Wiss. Wien*, Bd. xxxv., 1877; Reprint, p. 18.

<sup>2</sup> *Nye Alcyonider tilhørende Norges Fauna*, 1883.

<sup>3</sup> *Den Norske Nordhavs-Expedition, 1876-78*, xvii., *Zoologi. Alcyonida*, 1887.

Genus *Eunephthya*, Verrill.

*Eunephthya*, Verrill, Amer. Journ. Sci. and Arts., vol. xlvii. p. 284, 1869; Proc. Essex Inst., vol. vi. p. 80, 1869.

"Verrucæ prominent and covered with rough thorny, club-shaped or branched spicula, with the ends projecting from the surface."

Verrill formed this genus, with the above diagnosis, in the year 1869 for the northern *Alcyonium glomeratum*, Lützk., and for *Nephthya thyrsoidea*, Verrill, from the Cape of Good Hope, described by him in 1866.<sup>1</sup> The former name was later on changed into that of *Eunephthya lütkeni*, Verrill and Marenzeller, the latter into *Eunephthya thyrsoidea*, Verrill. Verrill also counts as a third species the *Nephthya nigra*, Pourt., discovered by Pourtalès at a depth of 120 to 152 fathoms in the Strait of Florida,<sup>2</sup> and names it *Eunephthya nigra*.<sup>3</sup>

The representatives of the genus *Eunephthya* may be generally characterised as branched Nephthyidæ of the habit of *Nephthya*, with the relatively large, club-shaped and non-retractile polyps thickly crowded together on the branches. In most species the polyps have the power of bending in towards the stem, in which condition they are always found in dead specimens.

In some species the polyps exhibit eight longitudinal markings on the surface. The tentacles are armed with spicules, and in repose and death are simply folded together over the mouth. The spicules are spindles, provided with branching spines and processes, spinose clubs, or branched spicules whose spines project beyond the surface of the outer coating, and give to the latter a rough surface.

The three hitherto known species of the genus come from temperate or cold seas, or from deep water in the warm zone.

The Challenger collection contains one specimen, which undoubtedly belongs to this genus, and it likewise comes from the temperate zone.

*Eunephthya fusca*, n. sp. (Pl. XXXVI. figs. 1a, 1b).

From a broad, elevated base rises a straight, upright stem, gradually diminishing in size upwards. After a short distance branches come off from the stem on all sides, bearing small twigs. On these, and on the apices of the branches, are placed the polyps to the number of three to seven. The polyps are large, and cover the branches and twigs completely, so that on a superficial view the stem appears to be surrounded with projecting lobes, in which the polyps are placed one above the other like roof-tiles. The

<sup>1</sup> Proc. Essex Inst., vol. iv. p. 148.

<sup>2</sup> Bull. Mus. Comp. Zool., 1868.

<sup>3</sup> Bull. Mus. Comp. Zool., vol. xi. p. 44, 1883.

polyps are large, club-shaped, with rough surfaces and without longitudinal markings. The tentacles are folded together over the mouth.

Height of the colony 38 mm. Greatest breadth 20 mm. Length of the sterile portion of the stem 6 mm. Length of a branch 8 mm. Size of a polyp 2 to 2.5 mm.; diameter of the same 1 to 1.3 mm.

The base covers over a fragment of a *Balanus*. The outer coating of the stem is tough, leathery, wrinkled, with a rough surface. In the lower part of the stem the branches are small, wart-like, with only three or four polyps; between them occur also individual isolated polyps. Higher up the branches become large and ramify. The summit is occupied by a number of short, upwardly tending branches.

The spicules fill the mesoderm of the stem, of the branches, and of the polyps, and extend into the tentacles. They are straight and curved spindles with large lateral spines, which bear numerous secondary dentations; sometimes lateral branched processes are developed. The dentations are often more developed on one side than on the other, the spindles possess lateral, warty processes, upon which strong, sometimes branched spines are developed. These spindles have the following dimensions. Length to breadth—0.09 by 0.05; 0.025 by 0.05; 0.09 by 0.04; 0.25 by 0.03 mm.

Besides the spindles there are also numerous spiny clubs, with one end slender and pointed, the other thickened and provided with simple or branched spines 0.1 by 0.07 mm. in size. Here also an asymmetry in the arrangement of the spines is frequently to be observed. There exist also numerous transition forms between these latter and the spindles. There are also twin forms, cross-shaped, 0.04 mm. in size; forked spicules, 0.16 mm. long, with a divergence of 0.07 mm., &c. All the spicules are of a brown colour. The entire colony has hence a dark sepia-brown hue. In this respect it agrees with *Eunephthya nigra*, Pourtales, but the polyps of the latter do not, according to Verrill, bend inwards, but stand out straight and have eight markings running down the sides.

*Habitat*.—Station 163A, off Port Jackson; lat. 36° 59' S., long. 150° 20' W.; depth, 150 fathoms.

### Genus *Spongodes*, Lesson, Verrill.

*Alcyonium (pars)*, Esper, Pflanzenthier, t. iii. p. 49.

*Spoggodes*, Lesson, Illustr. de Zool., 1834.

*Nephthya*, Ehb., Corallenthiere des rothen Meeres, p. 60.

*Spoggodia*, Dana, Zoophytes, p. 625, 1846.

*Spongodes*, Verrill, Proc. Essex. Inst., vol. vi. p. 81, 1869.

*Spoggodes*, *Spoggodia* et *Morchellana*, Gray, Proc. Zool. Soc. Lond., p. 27, 1862.

*Spongodes*, Klunzinger, Korallenthiere des rothen Meeres, p. 34, 1877.

Verrill has shown (*loc. cit.*) that the name adopted by Lesson, derived from the Greek σπογγώδης, spongy, should, according to accepted rules of orthography, be written in the Latin style, *Spongodes*; see also Klunzinger (*loc. cit.*).

Nephthyidæ of a very various form, but with the barren trunk always exhibiting a greater or less degree of development. The polyps are not retractile; their little heads, beset with large spicules, have a firm consistency and are overtopped by bundles of large, spindle-shaped spicules, which project like spines all over the colony. In the walls of the little heads the spicules are mostly placed obliquely, at the base of the tentacles they are arranged in a ring. The tentacles themselves are beset with spicules arranged *en chevron*. The walls of the polyp tubes and of the larger canals of the stem and branches are thin and fleshy; the surface of the colony, on the other hand, is hard and stiff, owing to the presence in the cœenchyma of numerous, spindle-shaped spicules.

The polyps are placed on the branches and twigs, several may be united in one bundle or they may be isolated and scattered. Gray (*loc. cit.*) attempted to base two genera upon this character, which he distinguished as *Spoggodes*, with the polyps united in bundles, and *Spoggodia*, with isolated polyps.

Verrill (*loc. cit.*) showed, however, that in certain species, *e.g.*, *Spongodes gigantea*, V., both characters are present in one and the same colony, so that the generic separation attempted by Gray falls to the ground.

The genus *Morchellana*, made by Gray (*loc. cit.*), must also, according to Ridley, who investigated the type,<sup>1</sup> be united with *Spongodes*.

For a long time only four species of the genus were known, viz., *Spongodes florida* (= *Alcyonium floridum*, Esper), *Spongodes celosia*, Less., *Spongodes arborescens*, Dana (Verrill), and *Spongodes savignii*, Ehrbg. The first three were regarded by Gray as synonymous with *Spongodes florida*, Esper, but nevertheless they must be considered as distinct species. In 1862 Gray added, from the material in the British Museum, four more species (five if we count *Morchellana*). In January 1864<sup>2</sup> Verrill described two new species, Klunzinger (*loc. cit.*) made two, and Ridley one,<sup>3</sup> so that at the present day the number of known species reaches fourteen. The collection made during the voyage of the Challenger contains twenty-two species, of which eighteen are new to science; if we add to these the six new species collected by Dr. Döderlein in Japan, and also the two new species mentioned below, the number as yet known reaches forty species (*vide* review of species, p. 225).

This great multiplicity in the development of the generic type appears to be due to the fact that most of the species inhabit shallow water, commonly the declivity of coral reefs, where the isolation of individual forms is greater, and at the same time the external conditions of life are subject to greater change, than in the case of the inhabitants of deep water. The same phenomenon is here repeated as in the case of the genus *Madrepora*. Most of the species are found within the tropical zone, at depths of from 10 to 70 fathoms, few range down to over 100 fathoms.

<sup>1</sup> *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ix. p. 186, 1882.

<sup>2</sup> *Bull. Mus. Comp. Zool.*, vol. i. p. 39.

<sup>3</sup> *Zoology of the Voyage of H.M.S. "Alert,"* p. 333.

According to the arrangement of the polyps on the stem we can distinguish three groups, which, it must be confessed, are not sharply marked off from one another, and are even connected with one another by intermediate forms. They are:—

**A. *Spicatæ*.**—The terminal twigs of the colony are thick, spike-shaped lobes, upon which the little polyp heads are directly and thickly placed. The general form reminds one more of *Alcyonium*.

**B. *Glomeratæ*.**—The little polyp heads are for the most part united in little bundles which are placed on peduncles on the terminal twigs (*Spoggodes*, Gray).

**C. *Divaricatæ*.**—The little polyp heads arise singly, generally on long peduncles (*Spoggodia*, Gray).

These three divisions correspond essentially with those established by Klunzinger in his work *Die Korallenthier des rothen Meeres* (p. 36), and are to be regarded only as provisional.

#### **A. *Spicatæ*.**

*Spongodes digitata*, n. sp. (Pl. XXXVI. figs. 2a, 2b).

Colony upright, consisting of a number of stems arising from a common base. The stems ramify irregularly, and finally terminate in numerous finger-shaped, cylindrical lobes, rounded at the end. Height of the colony, 75 mm. Thickness of one of the stems at the base, 12 to 16 mm. Length of a terminal lobe, 6 to 9 mm. Thickness of the same, 4 to 5 mm. The little polyp heads are overtopped by bundles of needle-like spicules; on the stem they occur isolated and scattered, on the branches they begin to group themselves more closely together, and finally they completely cover the finger-shaped lobes, on which they are densely crowded. The projecting portion of the polyp, which corresponds to the tentacular portion and the section containing the œsophageal tube, is narrower at the base, and terminates with the head-like, protruding, tentacular portion. The former is surrounded by large, needle-like spicules, of which a bundle of three or four is so strongly developed on one side that it projects beyond the head. Spicules are strongly developed in the head and tentacles.

The cœenchyma of the stem and branches is thickly beset with large spicules of a yellow colour. These spicules are horizontally arranged, and so closely packed together that no interspaces of soft tissue remain. They are stout spindles, straight or bent, often even bent into somewhat the shape of the letter *f*; they measure 0·9 to 1 mm. in length and 0·07 to 0·08 mm. in thickness. Their surface is thickly covered with small spines.

The bundles of spicules which project beyond the head consist of white-coloured, spiny, slightly curved spindles, which often appear to be somewhat enlarged at one end; their length reaches 0·86 to 1·4 mm.; their diameter 0·12 to 0·07 mm. The polyp heads,

which are flesh-coloured, contain little spiny needles, which are simply spindle-shaped or approach more or less nearly the shape of a club; they are straight or curved. They are arranged in eight tentacular groups, each group composed of two rows of spicules arranged *en chevron*, and finally continued into the base of the tentacles. Here the spicules are usually curved. Length to breadth—0·58 by 0·05; 0·25 by 0·025; 0·3 by 0·03; 0·2 by 0·03; 0·21 by 0·025; 0·18 by 0·04 mm.

The walls of the inner canals are not very thin, and are firm, whereby the colony acquires a fairly tough consistence.

The colour of the stem is yellow and of the little heads flesh-red.

*Habitat*.—Zebu Reef, Philippine Islands.

*Spongodes spicata*, n. sp. (Pl. XXXVI. figs. 1a, 1b).

The colony forms an irregularly branched lobose mass, which rises from a basal expansion growing over a stone.

One can distinguish a number of thicker main stems, which sometimes branch dichotomously and rise up from the base in diverse directions. These are covered with cylindrical, warty to finger-shaped, lateral twigs, which come off from the stem sometimes at obtuse angles and sometimes vertically, and are thickly covered with little polyp heads; they also often bear lateral processes covered with polyps, or again give off spike-like twigs. The form of these twigs most nearly recalls that of the flower-heads of *Phyteuma spicata*. The length of the stems reaches 115, 75, and 50 mm. Their thickness at the base, 28, 29, and 17 mm. The length of the ears, 12 to 16 mm.; their thickness 5 to 8 mm.

The consistence of the stem and branches is leathery.

The polyp heads occur partly scattered or united in groups on the stem and larger branches, and partly on the cylindrical terminal twigs, which they completely cover. Each head is surmounted by a stout bundle of spicules, which projects for a distance of 1 to 2 mm., and gives to the heads a spiny prickly appearance.

The spicules of the stem and branches are large spindles. They are horizontally placed, but not so closely as not to leave occasional gaps, which are filled up by the naked leathery tissue.

The spicules are large, spindle-shaped, often bent, and more blunted at one end than at the other, sometimes almost club-shaped, thickly covered with fine spines.

Their size reaches 1·5 by 0·1; 1·0 by 0·12; 1·3 by 0·08 mm.

The polyp heads are surmounted by bundles of rough spiny spicules, which are united together to the number of six. Their length reaches 1·2 to 3 mm., and their spines are more strongly developed than those of the stem spicules. In the heads the spicules are not so regularly arranged as in the preceding species. They are spindle-shaped, and

armed with pointed spines; size, 0.5 by 0.05; 0.25 by 0.04 mm. In the tentacles are found bent spicules armed with sharp spines, measuring 0.2 by 0.04 mm.

The canals in the stems and branches are wide and bounded by thin walls; in the more slender branches four main canals may be distinguished and in the terminal spikes two.

The colour of the stem is yellow, of the polyp heads greyish-white in spirit.

*Habitat*.—Zebu Reef, Philippine Islands.

*Spongodes nephthyaformis*, n. sp. (Pl. XXXVIA. figs. 1a, 1b).

The barren upright stem gives off branches at various heights, which may again bear lateral branches. All these are divided at the end into small, short, conical twigs, which are spike-like, and covered with little polyp heads. The latter are but slightly overtopped by the fine bundle of spicules which they carry.

The entire habit of the colony recalls much more that of *Nephthya* than that of *Spongodes*, and this impression is strengthened by the slight development of the spicules surmounting the little heads, whence the colony does not appear so prickly as other species.

The species is most closely related to *Spongodes savignyi*, Ehrenberg, but in that species the little polyp heads and also the spicules are larger and more prominent. The species must be referred to the genus *Spongodes*, because the polyps are placed sideways within a bundle of spicules, although these only project slightly. The main stem is 60 mm. high and 16 mm. thick at the base; it gives off branches at different heights, which measure 12 to 20 mm. in length, 6 to 8 mm. in diameter. In one specimen there arise from a common basal expansion smaller branched additional stems besides the main stem. Both stem and branches are divided at the end into a number of spike-like twigs, covered with small polyp heads. These little spikes are obtusely conical or lobose, and sometimes give off small lateral spikelets. Their length reaches 5 to 8 mm., with a diameter of 3 mm. The polyp heads are small, having a maximum size of 1 mm.

Externally the stem and branches are tough and leathery; they are thickly beset with rough, spindle-shaped, calcareous spicules, which are closely packed and cross one another, leaving no intervals. The spicules are often bent and covered with sharp spines. Their length reaches 1.1 mm., with a thickness of 0.05 mm.

The little polyp heads are supported by a bundle of broad spicules, which converge  $\Lambda$ -like to the number of six to eight. Their points project beyond the head, which is placed horizontally. They are slightly bent into the shape of a letter *f*, or straight, and they bear sharp-pointed spines. They reach 1.48 mm. in length and 0.08 mm. in breadth. At the base of the head lie spiny spindles, measuring 0.7 by 0.05 mm., which are bent parallel to the supporting spicules. The remaining spicules of the head lie

chiefly in the direction of the tentacles, up which they are finally continued. They measure 0·45 by 0·04; 0·27 by 0·03; 0·3 by 0·05 mm.

The colour of the colony in alcohol is a uniformly greyish-yellow. The spicules are white.

*Habitat*.—Admiralty Islands; depth, 25 fathoms.

## B. *Glomerata*.

a. *Lobata*.—The polyps distributed over the branches separately and in bundles.

*Spongodes carnea*, n. sp. (Pl. XXXVI. figs. 1a, 1b).

Consisting of a barren stem divided into two thick main branches, which again give off somewhat flattened stumps, at times lobose branchlets. These latter may again divide into short lobose twigs. The little polyp heads are seldom arranged singly, being generally united in groups and lobules on the upper end of the stem and on the branches, branchlets, and twigs. On the terminal twigs the groups are crowded more closely together, so that these are covered with polyp heads; but not in such a manner as to appear like spikes, as in the group *Spicata*, for here the individual lobules are still always distinguishable. Each group consists of three to ten polyp heads, each of which has a short peduncle and is surmounted by a long spicule. The peduncles unite together at the base, from which they either diverge like a crown or stand up in a row, so that the lobe appears to be compressed.

The colony reaches 155 mm. in height; the barren stem 45 mm., with a diameter of 35 mm. The main branch is 40 mm. long, with a tolerably uniform thickness of 18 mm. The lateral branches reach 34 mm. in length, the rounded terminal twigs 13 mm., with a thickness of 6 to 9 mm. at the end. The little polyp heads, so far as they are isolated, have a height of 2 mm., the spicules project for as much as 3 mm.

The stem and branches have thick, firm walls, which are leathery and thickly packed with fine spicules. The latter are not recognisable by the unassisted eye, and lie scattered confusedly in several layers. The canal-system in the interior consists of wide tubes, separated from one another by thin, soft, partition walls. The spicules in the outer covering of the stem have a very peculiar shape. They are broad, curved spindles, covered with strong erect warts, 1·0 mm. long and 0·1 mm. broad. There are also very numerous stellate forms, spheres covered with stout warts, and irregular biradiate spicules, all provided with often branching outgrowths, 0·08 mm. long and 0·025 mm. in diameter, 0·25 mm. to 0·18 mm., 0·36 mm. to 0·038 mm., &c. All these forms are intimately bound together, and they completely fill the thick connective tissue of the ectoderm.

In the lobules, from which the polyp heads arise, are found spiny spindles, which are



continued into the peduncle of the head, longitudinally arranged. Some of them are very long and strong, and project beyond the laterally placed head. They are long spindles, thickly covered with sharp spines; sometimes straight and sometimes curved into somewhat the shape of the letter *f*. They measure 1·3 by 0·08 mm.; 0·8 by 0·05 mm.; 2·5 by 0·19 mm. The largest spicules reach 3 mm.

At the base of the polyp head rise up, from amongst the thickly placed, spiny, peripheral spindles, eight long spicules, which are longitudinally placed and whose apices project beyond the mouth and the bases of the tentacles, forming eight rays around the oral region. These are slender and straightly pointed at the free end, while their lower quarter is bent at an angle, their length reaches 0·8 mm., the diameter 0·05 mm. The remaining spicules of the head measure 0·7 by 0·06 mm. and less.

The colour of the stem and branches is yellowish-white. The polyp heads, and, in part, the entire lobules are flesh-coloured; the spicules are red, or half red and half colourless; individual lobules are also white.

In habit the species comes nearest to *Spongodes studeri*, Ridley.

*Habitat*.—Tahiti; depth, 30 to 70 fathoms.

*β. Capitata*.—No specimen in the Challenger collection.

*γ. Umbellata*.—The bundles of the polyps are always placed at the end of the twigs on the finely ramified branches, which form an umbel.

*Spongodes spinosa*, Gray.

*Spongodes spinosa*, Gray, Proc. Zool. Soc. Lond., 1862, p. 27, pl. iv. figs. 5–7; *nee Spongodes spinosa*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 636.

Gray characterises the species as follows:—"The coral whitish, forming roundish spinose masses; the stem thick, slightly branched, with very numerous short branchlets; the spicules white, very unequal, some large and thick; the terminal branchlet furnished on the inner upper edge, with curved (in spirits) partly retracted purple polypes, which are surmounted and protected by the large opaque-white spicules of the branchlets." This description is of such a general nature that it can be applied to a large number of species, but it is sufficient to establish the difference from the only other species described from this group. The figures (*loc. cit.*, pl. iv. figs. 5–7) show a thick stem with no basal portion. From this are given off twigs, terminating in bundles of polyps. The polyp heads are surmounted by great white spicules and also show red spicules placed radially around the base of the head.

Two specimens in the Challenger collection, both from Torres Strait, may be referred to this species. One of them obviously belongs to the typical form, while the other may be distinguished as a variety with a lower ramification.

In the first the colony is upright and branched; 145 mm. high and 100 mm. broad. One can distinguish a barren cylindrical stem, 55 mm. high and 20 mm. thick, continued into a main stem which gives off larger and smaller polyp-bearing branches on all sides; the largest branch, 48 mm. long, belongs to the first series of branches.

The diversity in length of the branches gives to the surface of the polyp-bearing portion an irregular, knobby appearance. Each branch gives off in turn additional branches, which finally break up into little, diverging twigs, having bundles of five to ten, and more, polyp heads, each surmounted by a stout spicule. The bundles of polyps stand so closely together, that on the ramified head-like portion of the colony, only polyp heads, supported by spicules, are visible, and the branches and twigs are completely hidden. The polyp heads are placed on short peduncles surrounded by large spicules, one or two spicules project for about 1 mm. beyond the head.

Each polyp head is surrounded by a crown composed of eight groups of spicules, which reach from its base to above the origin of the tentacles.

The spicules are rough spindles, straight or *f*-shaped, at times somewhat enlarged at one end, almost club-shaped. Occasional examples, also, are forked at one end. In the twigs they are long and spindle-shaped, often thickened at one end and simple or *f*-shaped, with numerous spines, which are thickly placed and blunt at the end, or covered with fine warts or toothed. The smaller ones measure 0.6 by 0.05 mm.; 0.42 by 0.04 mm.; 0.54 by 0.12 mm. Larger spicules, thickened at one end, with branching spines, measure 1.5 by 0.25 mm. The large spicules lying in the peduncle of the polyp heads measure from 1 to 2.5 mm. in length, and 0.21 mm. in thickness. The large, slightly curved spicules measure 3 mm. in length by 0.14 to 0.26 mm. in breadth. In the head one distinguishes in the first place larger spicules, of which eight extend radially from the base to above the base of the tentacles; these are somewhat enlarged above and covered with sharp-pointed outwardly directed spines. They reach 0.4 by 0.057 mm. in size. Upon these are supported smaller needle-shaped spicules, converging outwards in eight groups towards the large spicule; these needle-shaped spicules are covered with sharp spines, and measure 0.3 mm. in length by 0.03 mm. in diameter.

The polyp-bearing portion of the colony is of a pale purple colour, mixed with white. The twigs are white; as are also the large spicules of the polyp peduncles and the larger spicules of the head. The smaller spicules of the heads and those of the tentacles are purple. The peduncle is reddish-white.

*Habitat*.—Station 186, Torres Strait; lat. 10° 30' S., long. 142° 18' E.; depth, 8 fathoms.

*Spongodes macrospina*, n. sp. (Pl. XXXVIb. figs. 2a, 2b).

The colony consists of a short, barren trunk, and a longish capitulum thickly covered with polyps. The trunk is prolonged into a thick, upright stem, from which stout branches arise on all sides. These latter soon divide into smaller branchlets from which arise twigs which bear the bundles of polyps. As the twigs are of equal length they form umbels of polyps, placed very close together, so that externally the head of the colony appears formed entirely of polyps. Those of the main branches of the stem are slightly larger than the others, and cause their umbels to project somewhat above the others.

The apex of the stem is branched at the end in the same manner as are the branches. While the twigs in the middle and upper portions of the colony are more cylindrical, those at the margin of the sterile portion appear to be more flattened, often arranged almost like a fan, and forming a collar around the barren trunk just below its upper end.

Height of the colony 120 mm. Greatest diameter of the capitulum 100 mm. Height of the sterile trunk 29 mm.; diameter of the same 33 mm.

The little polyp heads are united in bundles of from ten to twenty, which occupy the ends of the twigs. The heads themselves are almost terminal, and the large spicules of the peduncles do not project much beyond them, at the most 1 mm. These are generally very unequally developed, often scarcely overtopping the polyp head; usually only isolated spicules in an umbel project beyond the surface.

The trunk is of a dark red colour. It has a thick outer covering surrounding the wide canals, which are divided from one another by thin, soft, partition walls. The surface is finely granular. The entire mesoderm is filled with thickly packed spicules, which thus form a continuous layer. The form and size of the spicules are extraordinarily variable. One finds thick spindles of a dark red colour, covered with large, branched warts; size, 0·7 by 0·18 mm. The branching warts are often so strongly developed as to form lateral, branching processes, or the spicule appears to be forked at one end. In addition to the red spindles there occur also colourless ones, of similar form, spindle-shaped or forked, thickly covered with spiny warts; up to 1 mm. in length. Between these there are numerous small spicules of very various form, filling up all the intervals between the large spindles. They are sometimes stellate, sometimes spheres with branched thorny processes, sometimes twin spicules, and triradiate forms with spiny and warty processes; also curved and flattened spindles, &c., varying much in size. Branched spindles 0·4 mm. long to 0·3 mm. broad; stars 0·1 mm. to 0·12 mm.

In the polyp-bearing head the stem and branches assume a different character. One finds here spindles which are distinctly visible to the unassisted eye, lying in confusion across one another. These are seldom straight, generally undulating or

J-shaped; colourless. Their length reaches 4 to 6 mm., with a thickness of 0.43; 0.4; 0.3 mm. They are continued up the twigs and peduncles of the polyp heads, where they take on a red colour, or are coloured half red and half white. The spindles which overtop the head are mostly red, nearly straight, and measure 2 to 3 mm. in length. Besides the large spindles there are also numerous smaller ones, mostly slender and slightly curved; measuring 1 mm. in length by 0.067 mm. in breadth; 0.3 mm. in length by 0.05 mm. in breadth. These spicules give to the branches and twigs a hard, brittle consistence.

The polyp heads, whose peduncles are absolutely encrusted with thick spindles, are likewise armed with spicules. These stand vertically on the base of the polyp, and surround the heads radially up to a point above the bases of the tentacles. They are spiny spindles, with sharp, rigid spines. Sometimes the spindles are blunted above and provided with several spines at the end; or they may be club-shaped at the end with one or two spiny processes. Between the longer spindles occur also shorter curved spindles. The colour of these is generally that of yellow ochre, or red. Size 0.8 by 0.07 mm.; 0.67 by 0.05 mm.; 0.55 by 0.055 mm.; 0.54 by 0.1 mm. At the club-shaped end; 0.3 by 0.06 mm.; 0.3 by 0.05 mm.

The colour of the colony varies much in different parts. The barren trunk appears dark purple; the stem and branches white. The polyp-umbels in the lower portion of the head are yellow, for the spicules of the polyp heads are here self-coloured. In the upper portion they are dark brownish-red and yellowish. The spicules of the polyp peduncles are purple, those of the heads yellow.

*Habitat*.—Torres Strait; depth, 8 to 10 fathoms.

### *Spongodes florida* (Esper).

*Spongodes florida*, Gray, Proc. Zool. Soc. Lond., 1862, p. 27, pl. iv. figs. 1-4; *non Spongodes celosia*, Less.; *nec Spongodes celosia*, var. *arborescens*, Dana.

The fragment in the collection is the upper part of a colony. Gray's description with the help of the figure leaves no doubt as to the identity of the species. The twigs are arranged in umbels and bear bundles of from four to ten polyps, which are only slightly overtopped, each by a large spicule, and are hence almost terminal.

The white polyp heads are covered with spicules, which form eight groups. Each group is composed of two rows of spicules converging towards the base of the tentacles, and also produced up along the tentacles. The stem and branches contain large spicules of a dark red colour, which are irregularly scattered, leaving naked spaces of soft, leathery outer covering, these are slightly curved spindles covered with spines, which reach up to 4 mm. in length. In the twigs the spicules are more thickly crowded and arranged longitudinally; as they are also in the peduncles of the polyp heads. Here they are

slightly *f*-shaped, curved spindles, covered with sharp spines; size, 1.08 by 0.12 mm.; 0.79 by 0.058 mm. Between them lie smaller, very spiny spicules, which form thick rods covered with branching warts; size, 0.15 by 0.5 mm.; 0.2 by 0.05 mm.; 0.12 by 0.03 mm. At the base of the polyp heads occur slender, curved, bow-shaped spindles, whose concavity surrounds the heads; size 0.58 by 0.08 mm.

The white spicules of the heads are straight, very spiny spindles, reaching in size 0.58 by 0.08 to 0.12 by 0.03 mm. The colour of the colony is purple, that of the polyp heads and of the tentacles white.

This characteristic species is not, as Gray supposes, synonymous with *Spongodes celosia*, Lesson and Dana, which exhibits a totally different habit and a different mode of branching.

*Habitat*.—Station 212, off Samboangan; depth, 10 fathoms.

Gray gives Australia, Shark's Bay, and the Philippine Islands.

*Spongodes corymbosa*, n. sp. (Pl. XXXVIb. figs. 3a, 3b).

The entire colony exhibits a highly characteristic habit, which may best be compared to that of a corymb. One can distinguish a short, thick, barren trunk, and a spherical polyp-bearing head, composed of finely ramified branches arising on all sides. The branches bear terminal clusters of polyp heads. The consistency of the entire colony is soft and flabby, not rigid, for the spicules in the outer covering of the stem and branches are only sparingly developed, and the internal canals, separated from one another by thin walls, are very wide.

Height of the entire colony 93 mm.; greatest diameter of the head 90 mm. Height of the barren trunk 25 mm.; greatest diameter of the same 29 mm.

The barren trunk diminishes in size towards the base and is fixed to foreign substances by several stolon-like processes; its outer covering is thin and in spirits is plicated. It is continued into the branch-bearing stem, which markedly expands at the point of origin of the first branches, so that its diameter reaches 35 mm. The thick branches arise in a whorl around the stem immediately above the barren stem, and come off vertically. At the upper end the stem divides again into four large, upright branches, which form a kind of crown. Between the two whorls of branches there remains an unbranched portion of the stem, 20 mm. in height. At a short distance from their point of origin the branches fork into strongly diverging branchlets, and these into numerous twigs, all of equal size, to the number of three to five. The twigs bear little secondary twigs, and each of the latter terminates in a bundle of polyp heads. All the polyp heads develop to an equal length, so that each twig forms an umbel, in which the polyp heads represent the flowers. Each bundle of polyps, crowning the terminal twigs, consists of five to six individuals, whose heads are placed on short peduncles armed with large spicules. One of the spicules of each peduncle projects, for a slight distance only, beyond the little heads.

The barren stem has a rough, thin, somewhat flabby outer covering, in which lie numerous small, rough spicules. The thickly placed spicules are jagged structures whose shape may generally be reduced to the club-type. The largest are more spindle-shaped, provided with large spines, and expanded at one end into branching processes; size, 0.4 by 0.1 mm. Smaller forms also occur resembling foliaceous clubs, with branched, spiny processes; size, 0.2 by 0.12 mm. Most abundant, however, are forms which correspond to the spiny folia of a foliaceous club whose peduncle is almost entirely reduced; size, 0.13 by 0.08 mm.; 0.17 by 0.13 mm. Towards the head there occur, amid the above-mentioned forms, long, slender spindles, 2 to 2.5 mm. in length, which, owing to their red colour, stand out distinctly from the white ground formed by the outer covering of the stem. With the commencement of the ramification the long red spindles predominate, penetrating the mesoderm of the branches and branchlets. They lie in very various positions, transversely, longitudinally, and obliquely. In the more slender branchlets they have usually a longitudinal direction.

These spicules are not closely packed but are separated from one another by inter-spaces, so that each individual spicule is readily distinguishable. Their common form is that of a spindle, each spindle being covered with little, pointed, very closely placed spines. The spicules are frequently bent, or curved in a slightly undulating manner, more gradually attenuated at the one than at the other (blunter) end. Their length reaches 0.9 to 6 mm., with a diameter of 0.04; 0.05; 0.25; 0.4 mm.

In the twigs and secondary twigs occur long, white spindles, which are placed longitudinally and close together, and here give to the twigs a denser consistency. They are shaped like the foregoing, being straight, curved, and undulating, and thickly covered with fine, small spines. The largest are continued from the secondary twigs into the peduncle of the polyp heads, which they overtop; they reach 5 to 6 mm. in length, with a thickness of 0.3 to 0.44 mm. The smaller ones measure 1 by 0.06; 1.08 by 0.04 mm.

The spicules of the polyp heads are straight, slender spindles. Eight of the largest amongst these reach from the base to above the origin of the tentacles, like a crown. Between them lie smaller spindles which rest against the eight large spicules in eight groups; they completely fill the wall of the head. Their sizes reach 0.5 by 0.025 mm.; 0.5 by 0.033 mm., 0.43 by 0.033 mm., 0.25 by 0.001 mm.

The colour of the trunk is yellowish-white; that of the main and secondary branches pale purple; of the twigs, secondary twigs, and polyp heads, white.

In its mode of branching this species recalls *Spongodes florida*, but is distinguished by the more regular growth, and especially by the shape of the polyp heads and by the spicules.

*Habitat*.—Station 188, Arafura Sea; lat. 9° 59' S., long. 139° 42' E.; depth, 28 fathoms; bottom, green mud.

*Spongodes umbellata*, n. sp. (Pl. XXXVI. figs. 3a, 3b).

The colony forms a bush-like mass, branched from the base upwards; the terminal twigs forming flat polyp-bearing umbels.

The lower end of the stem has been torn off, so that it is impossible to decide whether we are dealing with a complete colony or perhaps only with a branch of a larger colony. The piece in the collection is, however, sufficiently characteristic to render possible a description of the species.

Horizontal, flat branches radiate on all sides from a median stem-portion. The length of the branches reaches 25 mm. Another short, ramified branch goes up from the middle. Each branch, after a short distance (7 to 8 mm.), divides into a number (two to three) of secondary branches, diverging at acute angles and turning upwards and to the sides; these always divide into three or four twigs whose small secondary twigs bear bundles of polyps. All the twigs reach to the same level, so as to give rise to copious umbels. These flat, expanded umbels mutually touch one another, only a few project beyond the remainder, so that, finally, the entire surface of the colony forms a single, flat, umbellate form, covered with polyps; while the lower surface shows the horizontally expanded ramifications.

Diameter of the colony 45 mm. Length of the twigs 3 to 4 mm. The end of each twig exhibits a bundle of ten to twelve closely crowded polyp heads. The heads are only slightly surmounted by rigid spicules. The consistency of the whole is flexible, but not flabby.

The outer covering of the stem and branches is thickly filled with larger and smaller pointed spindles. These are mostly *f*-shaped; in the branches they are more transversely placed, in the twigs, on the contrary, they are longitudinally arranged; their length reaches 4 mm., in the peduncles of the polyps the projecting spicules may reach 5 mm. in length. These spindles are generally slender, more or less rounded off at the ends, and covered with small, rigid spines. Only on the two ends are small warts developed. The size of the spindles reaches 0·8 by 0·05 mm.; 0·9 by 0·05 mm.; 1 by 0·05 mm.; 1·2 by 0·06 mm.; 5 by 0·2 mm. They are seldom straight, generally simply bent, or more or less *f*-shaped.

The polyp heads are small, surmounted from their base upwards by stout, purplish-red spicules, which project beyond the margins.

The tentacles, armed with small spicules, are white. The red spicules of the head are pointed; size, 0·72 by 0·04; 0·3 by 0·03; 0·18 by 0·01 mm.

Colour of the colony.—The umbels purple; all the polyp heads purplish-red, branches and twigs white.

*Habitat*.—Torres Strait; depth, 8 to 11 fathoms.

*Spongodes dendrophyta*, n. sp. (Pl. XXXVIc. figs. 2a, 2b).

Resembling *Spongodes florida* and *Spongodes corymbosa*, but more luxuriantly and loosely branched, with the polyps surmounted by large, spiny spinules.

The upright stem consists of a short, spindle-shaped, barren trunk, which is attached at the base by means of stolon-like processes to Mussel shells, fragments of stone, grains of sand, &c., and a thick stem-portion from which numerous loosely ramified branches are given off on all sides, bearing at their ends umbels of polyps. Owing to the loose ramification and the distances which separate the different umbels of each twig, the stem and branches, together with their offsets, are visible everywhere in the polyp-bearing portions of the colony. The branches are of different lengths, so that the umbels project for various distances, and the entire colony calls to mind a luxuriantly branched tree.

The whole colony is 100 mm. high and 85 mm. in greatest diameter. The length of the barren trunk is 20 mm., and its diameter 18 mm. Length of one of the larger branches 36 mm. Diameter at the base 12 mm.

The stem diminishes somewhat in size below, with a rather flabby outer covering, which when dry becomes wrinkled. At a height of 20 mm. the first branches come off around the circumference; they are not, however, all at the same level, but some are higher than others. The branches are broad and flattened from above downwards; ramification takes place for the most part in a plane perpendicular to the long axis of the stem. Coming off straight from the latter their twigs sink downwards somewhat, and thus protect, roof-like, the upper portion of the trunk. Further up the stem, which increases somewhat in diameter, arise irregularly and from all sides several larger branches, which quickly ramify. At first they come off at right angles, but their twigs are placed more vertically and directed towards the summit; in shape they are more cylindrical than the first set.

The end of the stem bifurcates into two short divergent branches. The ramification of the branches is analogous with that of the stem. The lateral branches arise at different heights; from these twigs come off, whose secondary twigs finally bear the groups of polyps. Since the twigs grow to about equal heights their secondary twigs form, with the polyp heads, umbels. Owing to the strong divergence of the secondary branches the umbels of one and the same secondary branch again form, amongst themselves, larger umbel-like groups. Each terminal twig bears a bundle of five to seven polyps, whose heads are surmounted by large spicules projecting like needles above the umbels.

The entire colony is somewhat flabby, only the terminal twigs and the umbels are more rigid.

In the barren trunk the mesoderm of the lower portion is filled with red spicules of a peculiar shape, disposed at regular distances from one another. They are mostly crosses, whose arms are placed vertically or obliquely to one another, like an X, and which may



generally be traced back to twin structures. Their diameter reaches on an average 0.3 mm.; sometimes one arm becomes abortive, so that irregular triradiate forms arise; rather large spines, placed at wide distances apart, give them a prickly surface. Owing to the presence of these bodies the outer covering of the trunk acquires a finely granular character.

In addition to these crosses we meet with spindles in the base of the trunk. These are elongated, *f*-shaped, pointed at both ends, and covered with fine, sharp spines; they are red or white, up to 2 mm. in length and 0.08 to 0.1 mm. in diameter. In the upper portion of the trunk the spindles predominate, and, owing to their red colour, they are individually distinctly recognisable with the unassisted eye. In the polyp-bearing portion these spicules are mixed with white ones, up to 4 mm. in length. These latter are irregularly arranged in transverse and oblique bands, always so as to leave soft interspaces between them. In the branches they are mostly transversely placed, but in the secondary branches and twigs they take on more of a longitudinal direction. In the twigs and secondary twigs they are mostly white, and are packed so closely together that they give to the outer covering in these places a hard rigid character. A bundle of spicules is developed in each little polyp head, and one particular spicule of the bundle projects above the head for a distance of up to about 2 mm. This spicule is armed in a slightly sinuous manner; it is half red and half white, and is thickly covered with fine spines; length, up to 4 mm., diameter 0.1 mm. The other spindles measure as follows:—3 mm. by 0.07 mm., red; 1.2 mm. by 0.067 mm., white; 0.83 mm. by 0.08 mm. These spicules are generally bent so as to become somewhat *f*-shaped; frequently they are sharp at one end and more blunted at the other. The bases of the polyp heads are surrounded by bent spicules arranged in a row; from these arise spiny spindles directed towards the margin, and from these arise eight more, which project above the bases of the tentacles, like needles. They are generally somewhat bent and blunted at one end, at the other end they are sharper and covered with little upright spines; length 0.58 mm., diameter 0.04 mm.

In the colour of the colony a yellowish-white prevails, mixed with red here and there. The base of the trunk is a bright purple, the stem, branches, and twigs are yellowish-white, purple spicules occur only here and there, isolated or in tracts. The polyp heads appear reddish, between them appear the purple spicules, which project above the heads.

*Habitat*.—Station 203, lat. 11° 6' N., long. 123° 9' E.; Philippine Islands; depth, 20 fathoms; bottom, mud.

*Spongodes anguina*, n. sp.

The colony consists of a long, cylindrical, flabby stem, dividing at the end into a number of branches; these, speedily ramifying, bear at the end umbels of polyps.

The polyp-bearing portion thus appears as a spherical head placed on a long stalk. The entire colony is 180 mm. high; of this 150 mm. belongs to the barren stalk, whose attachment is wanting. The maximum diameter of the head portion is 43 mm.; that of the stalk, in the lower third, where it is thickest, 10 mm. The same relations of stalk to head are also exhibited in a younger specimen, 90 mm. long; the length of the stalk in this case reaches 80 mm. In the first case the relation of stalk to head is as 5 to 1, but a portion of the stalk is wanting; in the second case it is as 8 to 1. From the commencement of the branches the stem increases considerably in diameter. First of all eight stout branches are given off at the same level around the stem, which stands out almost straight. Above these comes a second whorl of branches, directed more upwards. These are united at their bases and surround the apex of the stem like a funnel. The branches quickly ramify into divergent secondary branches, and these into twigs, which bear the bundles of polyp heads on their lateral portions. Since the twigs are all of equal length the polyps form umbels which touch one another, but those belonging to a secondary branch always form a distinctly defined group. The terminal twigs bear bundles of from five to ten polyps; only the heads of the polyps, which are slightly overtopped by a bundle of spicules, are separated from one another.

The outer covering of the stalk is of a somewhat soft and fleshy consistency, its mesoderm contains only a few spicules scattered at wide distances. These spicules are twin structures, stars with four or more rays and projecting spines. In a space of 4 square mm. there are at most four or five, 0.12 mm. in size; but there are, in addition, fine calcareous granules without any definite shape. Even the branches and secondary branches still have the soft, fleshy character of the stalk; but in the twigs and secondary twigs we begin to find spicules, generally longitudinally placed, and forming in the polyp bundles a rigid armature. They are somewhat sinuous spindles, slender, somewhat blunted at both ends and thickly covered with fine spines. In the peduncles of the polyp heads they form groups of stout spindles, which converge together upwards, and form projecting points above the polyp heads. In the twigs the spindles are white, in the peduncles of the polyps they are purple.

The white spicules measure 1.5 by 0.06 mm.; 1.5 by 0.05 mm.; the red ones 0.8 by 0.08 mm.; 1 by 0.05 mm.; 1 by 0.016 mm.; 1 by 0.08 mm.

In the polyp heads we find fine spicules arranged in eight groups; in which each two rows of spindles converge towards the base of the tentacles, ending finally in eight tooth-like projections above the origin of the tentacles, so that the head forms a calyx with eight marginal teeth. The spicules of the head are red. They reach in size 0.5 by 0.03 mm. 0.4 by 0.03 mm.; 0.2 by 0.03 mm.

The tentacles, which can be bent inwards, are covered with fine yellowish spicules, arranged *en chevron*; size of spicules 0.09 by 0.01 mm.; 0.12 by 0.02 mm.

Stalk, branches, and twigs are yellowish-white; the polyps are red, the tentacles yellowish-white.

*Habitat*.—Station 212, off Samboangan; lat.  $6^{\circ} 54' N.$ , long.  $122^{\circ} 18' E.$ ; depth, 10 fathoms; bottom, sand.

*Spongodes bicolor*, n. sp. (Pl. XXXVIc. figs. 1a, 1b).

The colony consists of an elongated, rather slender, barren trunk, continued above into a broader stem-portion, from which latter larger and smaller branches come off, ramifying and being covered at the ends with polyps. The branches are of various sizes, so that the polyp-bearing head thereby acquires an irregularly lobose form.

Height of the colony 120 mm.; greatest breadth of the head portion 76 mm.; length of the barren trunk 60 mm.; diameter of the same 13 mm.; height of the head portion 60 mm.; length of a main branch 34 mm. The stalk arises from a flat expansion as a cylindrical trunk, which in spirits appears to be strongly plicated, and has a rough, granular surface. It is somewhat flabby and flexible. On passing into the head-portion it increases in thickness, gives off larger and smaller branches at right angles, and radiates at the apex into an umbel of divergent branches.

The branches are sometimes cylindrical, but frequently, especially in the lower division of the head, flattened, forming flat, projecting expansions rather than branches, which surround a portion of the periphery of the stem. At the end they give off, often after further ramification, small, divergent twigs which bear bundles of sixteen to twenty polyp heads. Each of these, together with its peduncle, is isolated for a short distance and surmounted by a bundle of needles which projects for 2 or 3 mm. above the head. The branches do not arise very close to one another, and the ramification is sufficiently loose to show the main stem and the branches between. The polyp heads are surrounded by eight rows of spicules, each of which projects above the folded tentacles.

The spicules of the barren trunk are thickly packed together in the outer covering, so as to give it a tough consistency and a rough surface. Their shape and size vary very much, scarcely any two spicules being alike. All, however, are provided with stout warts and spines, which are often branched, by means of which their margins mutually interlock.

The principal forms are as follows:—Straight spindles with blunt ends and covered all over with large warts directed towards the two ends; size, 0.79 to 0.8 by 0.12 to 0.2 mm. Curved, warty spindles, sometimes bow-shaped, sometimes geniculate, and provided at the angle with rather sharp, often branched spines; size, 0.5 by 0.13 mm.; 0.4 by 0.1 mm. Simple clubs or spiny clubs with branched spines; size, 0.7 by 0.17 mm.; 0.34 by 0.17 mm.; 0.5 by 0.13 mm. Straight spicules, sharpened at one end and provided at the other with two or three diverging processes, covered on all sides with

sharp spines; size, 0·91 by 0·29 mm.; 1·1 by 0·2 mm., in the middle 0·58 mm. between the apices of the divergent processes. Double and quadruple structures, forming four to eight-rayed stars, 0·28 mm. in diameter, or forming irregular, jagged, almost shapeless calcareous bodies.

In the polyp-bearing head-portion of the stem and in the branches the variously-shaped spicules give place to spindles, which, at first placed transversely, in the twigs become arranged in longitudinal bands which are finally prolonged up the peduncles of the polyp heads. These spindles are long, either pointed at both ends or rounded off at one end, seldom straight, generally slightly bent or *f*-shaped. They are very thickly covered with fine, sharp spines. Their length reaches 0·6, 0·9 to 1 mm., with a thickness of 0·08 to 0·1 mm. In the peduncle of the polyp heads they form the bundles of spicules which surmount the latter; here the spindles reach a length of 3 mm., with a diameter of 0·21 mm. Frequently in these spicules one end appears to be truncated and produced into two short processes. The polyp heads are surrounded by eight groups of spicules directed from the base to the origin of the tentacles, and projecting like teeth somewhat above the latter. They are straight or slightly bent spindles and rods, covered with fine spines. They measure 0·6 by 0·05 mm.; 0·58 by 0·033 mm.; 0·3 by 0·025 mm.; 0·33 by 0·033 mm.; 0·2 by 0·033 mm.

The tentacles are folded together in repose and are covered with small red spicules. The colour of the colony is various. The trunk is greyish-white, the branches and twigs white. The polyp heads on many branches are dark flesh-coloured, owing to the red spicules; on others they are only yellow.

*Habitat*.—Torres Strait; depth, 8 to 11 fathoms.

Station 212, off Samboangan; depth, 10 fathoms. A young colony.

*Spongodes collaris*, n. sp.

The colony consists of an upright barren trunk and a polyp-bearing head, arranged in such a manner that the stem gives off at right angles, from its upper end, up to four branches, which, soon ramifying, bear umbels of polyps at their ends.

Halfway up the trunk in young colonies, and two-thirds of the way up in an older colony, there occurs a zone of flat projecting welts or folds around the stem. These form a kind of collar around the stem and their margin is covered with rows of polyps.

The trunk is fixed in the ground by means of tubular, stolon-like processes. From these it rises, increasing little in size, until it divides into the aforesaid branches, which come off from it at right angles. Up to the collar its outer covering is tough and rough, in spirit but slightly folded, and even in the dry state collapsing but slightly. Above the collar its consistency becomes softer; tracts of large obliquely and transversely placed spicules are visible to the unassisted eye, having intervening gaps of soft

skin. The same applies to the branches and twigs, only here the long, calcareous spindles are more closely packed.

The branches given off from the end of the stem are short and cylindrical, and subdivide at the end, like the main stem, into three secondary branches. The secondary branches finally divide into small twigs, all of equal size, bearing the polyp heads united together in bundles of from ten to twenty. The polyp bundles which belong to one branch are closely crowded together, and thus separate umbels are formed. Exceptionally two lateral branches occur on one branch, coming off at right angles at a short distance above its origin.

The individual polyp heads are always surmounted by a short bundle of spicules. The former, together with their peduncles, are isolated for a short distance, and some individuals in a bundle are usually more completely isolated than others, above which they then project. Each head is surrounded at the margin by a crown of eight spicules, which can be folded together over the mouth and tentacles.

In a quite young colony the bundles are made up of a very few polyps, three to five in number. These polyps are fairly well isolated from one another; the more tightly-packed and thickly-placed bundles originate by the development of new polyps between the old polyps. The original parent polyps, however, still retain a certain degree of isolation.

The collar consists of a number of flat folds, disposed around the stem in a circle; the margins of these folds are covered with polyps arranged in rows. Five of these projecting, half-moon-shaped or lobose folds, separated by varying interspaces, constitute the collar-like ring on the stem of the larger colony. In a young specimen there are five separate groups of long polyps arranged in rows. These polyps are separate from one another almost down to the stem, while in the older colony they are, in part, united together up to the head, and are also not always confined to a single row, but sometimes occur in two or three rows above one another. The form of these polyps is the same as those of the branches, only the projecting bundle of spicules is in them still less developed.

	Rather old Colony.	Medium Colony.	Young Colony.
Height of the colony to the upper end of the peduncle, . . . . .	60 mm.	31 mm.	20 mm.
Length of the trunk up to the collar, . . . . .	40 „	9 „ (the lower end is wanting.)	10 „
Diameter of the trunk below the collar, . . . . .	20 „		
Length of a branch, . . . . .	20 „	17 „	9 „
Diameter of a branch, . . . . .	8 „	6 „	2-3 „
Size of a polyp from the collar, . . . . .	2 „	2 „	2 „
Size of a polyp from a twig, . . . . .	1.5-2 „	1.5-2 „	2 „

The outer covering of the trunk up to the collar is thickly beset with spicules, which, placed close together, form a continuous sheath. These spicules consist, in the more simple cases, of short thick spindles covered with long and usually branched curved spines placed in several circles. They are 0.3 mm. long and 0.13 mm. in diameter. They are frequently bent and then the convex side is covered with longer spines, like the spicules of many Muriceids; length 0.28 mm., diameter 0.07 mm. There are also club-shaped spicules, whose thicker end is covered with branched prickly spines; size, 0.25 by 0.15 mm. and 1.8 by 0.08 mm. There are, further, double forms, in the shape of a cross, whose rays bear jagged, branching spines; diameter 0.32 mm. The branching spines serve to unite the spicules together by interlocking with one another, and thus to form a continuous armature. Above the collar these forms disappear, and in their place long bent spindles occur in the mesoderm. These are usually placed at right angles to the long axis of the stem and branches, in which they alone occur. Their length reaches 2 to 4 mm. Spaces filled with soft skin are left between them, so that here the outer covering is flabbier than in the lower part of the trunk.

In the finer twigs these spicules are arranged longitudinally and pass into the peduncles of the polyp heads, beyond which they project in the form of fine spines. These spicules are spindle-shaped, they are often bent so as to become *f*-shaped and truncated at one end; they are covered all over with fine spines. They measure 0.8 by 0.04 mm., 2 by 0.07 mm., 4 by 0.09 mm.; the latter in the bundle of spicules surmounting the head.

The peduncle of the polyp head is heavily armed with large *f*-shaped spicules. The polyp head is surrounded by larger and smaller spicules which radiate from the base to the margin, beyond which eight of them project like spines. These are bent and truncated at the base, or forked and completely covered with sharp little spines. They measure 0.8 by 0.5 mm., 0.7 by 0.038 mm. The smaller spindles, which are either straight or bent, measure 0.26 by 0.03, 0.3 by 0.02, 0.3 by 0.025 mm. Small spicules occur embedded in the tentacles.

The colour of the stem and of the branches and secondary branches is white; that of the terminal twigs and polyps, as also of their spicules, is purple. The polyps of the collar are bright red, in one case white. The tentacles are white.

*Habitat*.—Station 192, off the Ki Islands; lat. 5° 49' 15" S., long. 132° 14' 5" E.; depth, 140 fathoms; bottom, blue mud.

*Spongodes heterocyathus*, n. sp. (Pl. XXXVI. figs. 3a, 3b).

The colony consists of a globular head formed by the rapid ramifications of a short stem, whose terminal twigs bear bundles of polyps. One larger polyp, of special

structure, projects beyond the remainder in each of these bundles. The entire colony is rigid, neither branches nor stem being flexible. The height of the colony reaches 21 mm.; its diameter 30 mm.

The short, thick stem, which is attached to a *Balanus* by means of a broad base, gives off immediately above its origin a whorl of eight branches coming off at right angles. With a diameter of 9 mm. it thence rises to a height of 6 mm., at which point it divides into four terminal branches directed obliquely outwards. The length of one of the lower branches is 8 mm., that of one of the upper ones on an average 6 to 7 mm. The ramification of the branches takes place in the following manner:—Each branch at a short distance from its origin, divides into two secondary branches, which come off at various angles, sometimes at right angles and sometimes at rather an acute angle. In the case of the lowermost branches the secondary branches, which are moreover somewhat flattened, are directed towards the base of the colony, and thus cover up the root, their twigs reaching the ground all round.

Each secondary branch gives off three, five, or more short, divergent twigs, which bear bundles of small polyps at the ends. The number of polyps in a bundle reaches as many as twelve. One larger polyp, 2 to 2·5 mm. in length, rises up from amongst them, while the little sessile polyps at its base measure 0·6 to 0·7 mm. in height. The central polyp is cylindrical, and is surmounted by from one to three thick spicules.

The polyp bundles of one secondary branch, and often even of only one twig, form isolated groups, separated by intervals from the neighbouring groups, so that the network of branches may be recognised between the polyps.

The stem and larger branches are filled with large, transversely placed, spindle-shaped spicules, which are usually *f*-shaped. In the secondary branches and twigs the large spicules, which here assume a longitudinal direction, are more sparsely developed, and hence the mesoderm becomes filled with very numerous, small, calcareous spindles, crossing one another in divers manners. In the terminal twigs one finds in the peduncles of the polyp heads larger parallel spindles, one of which projects slightly beyond the head. In the head only small spicules arranged *en chevron* are developed; these spicules form eight longitudinal bands, and are continued up the tentacles, which latter can be simply folded together and are not retractile.

In the case of the large polyps there occur large calcareous spindles, forming together quite a cylindrical tube. This tube has a lateral opening above, from which the little head, constructed like those of the small polyps, breaks out. Its base is surmounted by from one to three large spicules.

The spicules of the long polyps are thick, straight spindles, covered with fine spines; 1 to 2 to 2·5 mm. long, and 0·1 to 0·2 mm. in diameter. The smaller spindles, which are frequently *f*-shaped, measure 0·8 by 0·05; 0·5 by 0·07; 0·25 by 0·04 mm.

The colour of the stem and branches is whitish, of the twigs and polyp peduncles

rosy-red, of the polyp heads white. The prominence of the twigs causes the entire colony to appear externally of a rosy-red colour.

*Habitat*.—Torres Strait; depth, 8 to 11 fathoms.

### C. *Divaricata*.

The polyps on the terminal twigs are separated from one another by longer or shorter distances. No sharp division between this and the preceding division is possible, as will be seen from the foregoing observations. In the *Divaricata* the individual polyps are, however, completely separated from one another, and hence are easily distinguishable. Yet even in this group individual twigs occur in which two or more polyps have grown together up to the tentacle-bearing heads. A generic distinction between the two groups, such as Gray proposed, is on this account impossible.

a. *Umbelliferæ*.—The polyp heads are arranged in umbels.

*Spongodes coronata*, n. sp. (Pl. XXXVI. figs. 2a, 2b).

A very short barren trunk divides after a short course into two divergent branches. These are thickly covered with lateral branches coming off from them at right angles, which, after further ramification, bear umbels of polyps. In the umbels the individual polyps are free for a short space, and diverge from one another. The barren trunk is very short, 9 mm. high and 15 mm. thick; in spirits of wine it is soft and much shrivelled and folded. From it come off two thick, diverging branches, 45 to 54 mm. in length, which are covered with polyp-bearing twigs. The height of the entire colony reaches in one specimen 45 mm., with a breadth of 71 mm.; in a second the height is 50 mm. and the breadth 90 mm. The secondary branches come off all around the branches and are thickly covered with polyp-bearing twigs, so that from the outside only umbels of polyps are visible, which completely hide the ramifications. The secondary branches are short, measuring about 12 mm. in length, and come off at right angles; their ramifications take place as follows:—Each one, after a short course of about 5 mm., divides into a number of divergent twigs which finally break up into the polyp-bearing terminal twigs, and these last form together an umbel. All the twigs belonging to one secondary branch form a primary umbel, which may be separated from that of the adjacent secondary branch by a small interspace. The secondary twigs bear on an average eight polyps, whose short peduncles are separated from one another and diverge at acute angles.

The free portion of each polyp is 1·5 to 2 mm. long, and the head is 0·8 to 1 mm. in



diameter. On individual twigs, however, the polyps are sometimes more closely packed and united together up to the head, so as to recall the condition of the preceding group.

The stouter bundle of spicules, occurring in the polyp peduncle, is here very feebly developed, so that the little head appears to be almost terminal. The margin of the head is surmounted by eight bundles of spindles arranged *en chevron* and projecting like teeth. The wall of the stem and branches is rather flabby; it contains numerous calcareous spindles, which are for the most part placed transversely, and are not closely packed. These spindles are, as a rule, slightly *f*-shaped and surrounded with small, sharp spines. They measure 0·83 by 0·045 mm.; 1·2 by 0·05 mm.

In the twigs the spicules are longitudinally arranged, and in the terminal twigs they lie close together so as to give the outer covering a rather firm and hard consistence. Here they reach a length of 2·5 to 4 mm., with a diameter of 0·25 mm. In the polyp peduncles they are arranged close together; one bundle, situated on the dorsal aspect of the same, contains from one to two stouter spindles, measuring 1·67 mm. in length and 0·12 mm. in thickness; and the polyp head is placed on the side of this bundle. The head is surrounded at the base by a circle of smaller spicules which point towards the margin, and form finally eight bands arranged *en chevron*. These project above the margin like the points of a crown, but can also close together like a lid over the mouth.

The white spicules of the head measure 0·4 by 0·058; 0·3 by 0·054; 0·33 by 0·04; 0·32 by 0·025; 0·45 by 0·058 mm.

The colour of one specimen is a purplish-red, with white polyp heads. The branches are rather pale red, in consequence of the slight development of the red spicules; the twigs and secondary twigs are dark red. The colour of the second specimen is pale red, only individual twigs are darker; here also the polyp-heads are white.

*Habitat*.—Torres Strait; depth, 8 to 10 fathoms.

*Spongodes pustulosa*, n. sp. (Pl. XXXVIA. figs. 3a, 3b).

The colony consists of a cylindrical, barren trunk, attached at the base by means of stolon-like outgrowths to foreign bodies such as sand and Mussel shells, and an elongatedly oval or more irregularly shaped head part, covered with polyps. The entire colony is upright, and in one case the lower portion of the trunk is creeping and covered with stolons, and quite rigid. Everywhere stiff spicules project above the polyp heads, thus giving a spiny surface to the head portion. The little polyp heads contrast well with the darker twigs by reason of their white colour, they occur singly all over like little pustules.

Length of the trunk, . . .	30 mm.	40 mm.	70 mm.
Diameter of the same, . . .	10 „	10 „	15 „
Length of the head, . . .	34 „	38 „	40 „
Transverse diameter of same, . . .	32 „	39 „	42 „

The trunk has a leathery, rigid character, and a rough, granular surface. It is thickest towards the upper end, and gradually diminishes in size downwards. At its lower end come off thin, cylindrical stolons, which adhere to foreign bodies and sometimes clasp around them. In the largest specimen such stolons are given off from the lower fourth of the stem, which is bent round horizontally.

The stem is prolonged into the polyp-bearing head-portion, giving off larger and smaller branches on all sides, and dividing at the end into two or three branches. The branches stand out partly at right angles and are partly directed somewhat obliquely upwards, especially the upper ones. Their ramification recalls very much that of the preceding species. Usually several secondary branches come off from one short branch. These branches terminate in a number of twigs. The twigs form together an umbel, with a number of from five to eight divergent, stipitate polyps, which with their stalks attain a length of 2 mm., with a diameter of 0·8 mm. in the head. Owing to the divergence of the terminal polyps each head appears from without to be isolated and separated from the next by an interspace, yet the umbels are so close to one another that the ramifications of the branches are only indistinctly visible between them. The average length of the branches, up to the end of the ramifications, is 8 to 12 mm.; the diameter of an umbel 12 to 15 mm. The little heads are surmounted to a greater or less extent by a spicule belonging to the peduncle, their own spicules are arranged *en chevron* from the base to the margin, but do not form tooth-like projections; hence the tentacles are covered with stiff spicules which, when they are folded together, form a quasi-opercular covering.

The mesoderm of the trunk is thickly packed with numerous variously-shaped spicules, which form a complete coat of mail. These are thick spindles covered with knotty or branched warts, placed in close successive whorls; length 1·3 mm., breadth 0·17 mm. There are also short spindles of similar shape with truncated ends, often bent, and then covered on the convex side with rather stout, branched processes and warts, length 0·3 mm., breadth 0·12 mm. Often there occur also twin forms, in the shape of irregular warty crosses and stars, measuring 0·3 by 0·17 mm.; also little jagged calcareous bodies, often club-shaped, with branched outgrowths, 0·12 mm. long by 0·08 mm. thick, and quite irregular forms measuring 0·1 by 0·06 mm. The larger spicules are usually white, the smaller irregular forms orange. The stalk has always a more intense orange, or a paler yellowish colour, according to the predominance of one or the other kind of spicule. Where the branches begin long spindles occur, which soon completely supplant the other spicules, and are chiefly placed transversely. These spindles are slender, curved, usually *f*-shaped, and covered with fine spines, they are of a yellowish, white, or rosy-red colour.

In the branches and twigs they are longitudinally placed and lie close together, and in the terminal twigs and the peduncles of the polyp heads they form a coherent coat of mail. The colour is very various, white, orange, purple, often half red and half white. The principal sizes are 0·8 by 0·08 mm.; 0·4 by 0·03 mm.; 0·8 by 0·05 mm.; 1·7 by 0·12 mm.; 1·2 by 0·56 mm.; 4·0 by 0·3 mm.; 5·0 by 0·29 mm. The head is surmounted by a spicule for as much as 1 mm. At the base of the head fine white spicules occur, arranged in a circle; then they become elevated and form eight bands of spicules arranged *en chevron*. The tentacles are protected by flatish spicules toothed at the margin, 0·12 mm. long, and 0·03 mm. in diameter. The colour of the polyp heads is always white, that of the branches and twigs very various, even on one and the same colony; white or orange or purplish-red. In two colonies the upper branches are purple, the lower ones orange; in a third the upper ones are white, and the lower ones orange. The trunk is always orange, sometimes bright yellowish towards the upper end.

*Habitat*.—Tahiti; depth, 30 to 70 fathoms.

*Spongodes monticulosa*, n. sp. (Pl. XXXVIc. figs. 3a, 3b).

In its mode of branching and in the condition of the polyps this species very much resembles the two preceding ones, so that on superficial observation one might be tempted to regard it as a special growth from off a *Spongodes pustulosa*. A more careful examination compels one, however, to make a distinct species of it.

The colony consists of a cylindrical stalk, fixed in the sand by means of stolons, and a head portion thickly covered with polyps. The head appears to be spread out, especially in one plane, and its surface is divided into four roundish, spherical lobes, which, however, are not completely separated from one another.

Height of the colony,	.	.	.	.	.	.	65 mm.
Height of the sterile trunk,	.	.	.	.	.	.	23 „
Thickness of the same,	.	.	.	.	.	.	12 „
Greatest diameter of the head portion,	.	.	.	.	.	.	69 „

The stalk gives off at its base numerous cylindrical, partly ramified stolons, which attach themselves to grains of sand and fragments of Mussel shells. Its consistence is rather flabby; the outer covering is soft and yielding, almost falling together in folds, yet it is filled with spicules and has a rough, granular feel. In the polyp-bearing head-portion the stalk is continued, giving off larger and smaller branches, until it divides at the end into two short branches. Two large branches come off at the same level, but in two directions from the upper end of the barren part; one of them attains a length of 32 mm.

The four main branches, as well as the stem, are surrounded by short secondary

branches, which come off at right angles and immediately divide into a large number of divergent twigs which bear the polyps at their ends. Each twig bears, on an average, five polyps. Owing to the regular ramification each secondary branch, as well as the smaller main branches, forms a short, convex umbel. All the umbels are crowded together so that each branch appears to be covered with a continuous coat of polyps. The polyp umbels of the four main branches themselves are likewise crowded together. The area of each only appears defined by a groove, owing to the different development as regards length, so that the areas of the branches correspond to four convex protuberances. The polyp heads, each of which appears distinctly isolated on the surface, are placed singly on short peduncles, 1 to 0.8 mm. in length; the older ones on a twig, being usually more prominent than the others. They diverge somewhat from one another, and are surmounted each by a rigid spicule for a distance of 0.5 to 0.8 mm., upon which they appear to be laterally placed. The diameter of the head reaches 0.8 mm.

The twigs, like the polyp heads, are usually stiff and rigid, owing to the numerous calcareous spicules embedded in the mesoderm. More especially may be noticed amongst these a band of large spindles which occupies the portion of the twig and of the polyp peduncle, which is turned away from the head. The spicule which surmounts each head projects from amongst these spicules. The mesoderm of the barren part of the stem, which is penetrated by very wide canals, contains numerous spicules of special shape, easily distinguishable from those of the preceding species.

The following are the principal forms which occur:—(1) Small spicules, usually in the form of quadriradiate structures, sometimes in the form of an oblique cross, sometimes of more irregular shape, and covered with spines, warts, or jagged branching processes. Size, 0.2 by 0.13; 0.15 by 0.14; 0.12 by 0.08 mm. (2) *f*-shaped spindles, thickly covered with short, branched warts. Size, 1.0 by 0.13 mm. (3) Simple, curved spindles, covered with sharp spines, which bear in the centre, where they are broadest, branched, thorny processes; length, 0.51 by 0.1 mm. (4) Club-shaped structures, 0.31 mm. long and 0.1 mm. broad at the thickened end, where they bear branched spines.

In the polyp-bearing portion there occur, in place of these structures, straight, slender spindles, covered with fine spines, or such as are slightly curved or *f*-shaped. In the stem and main branches they are chiefly placed transversely; in the twigs they form longitudinal bands, of which one, on the dorsal side of the twig and of the peduncle, is especially developed and distinguished by the great development of the spicules. Here the spicules are 3 to 4 mm. long, with a diameter of 0.2 mm. Their surface is covered with very fine spines, and one end is often shortly bifurcate. The smaller spicules have the following dimensions—length to thickness, 1 by 0.07 mm.; 0.92 by 0.04 mm.

The spicules of the polyp heads are usually arranged *en chevron* in eight series;

they project above the margin in eight small teeth. The base of each tentacle contains two long spindles, converging together towards the apex in the form of a V, between which may lie another median spindle. These form a tentacular cover. The spicules of the head measure 0.63 by 0.05 mm.; 0.5 by 0.02 mm., &c.

The colour of the colony varies throughout according to the locality. The stem and branches are yellowish-white, and in the branches there occur individual purple spicules. The twigs on isolated branches are yellowish-white, but on most are purple. The polyp heads are always white.

*Habitat*.—Station 188, Arafura Sea; lat. 9° 59' S., long. 139° 42' E.; depth, 28 fathoms; bottom, green mud.

*β. Laxæ*.—The polyp heads occur in loose groups on the scattered twigs.

*Spongodes laxa*, n. sp. (Pl. XXXVI. figs. 5a, 5b).

The stem is flabby, cylindrical, it is simply rounded off and smooth at the base, giving off flabby branches at wide intervals on two sides. The branches, just like the main stem, are loosely covered with small secondary branches coming straight off from them; these are provided with divergent twigs which bear the polyps. The polyps have long peduncles and come off at long distances from one another.

Length of the colony,	.	.	.	.	82 mm.
Thickness of the main stem near the base,	.	.	.	.	12 „
Length of one of the larger branches,	.	.	.	.	30-40 „
Length of the secondary branches,	.	.	.	.	6-8 „

The main stem gradually diminishes in size from the base to the apex, it is simply rounded off at the bottom, without any root-portion which might serve to fix it to the substratum. But some small, wart-like protuberances may represent scars indicating that the stem became constricted off from a basal portion, or that it originally developed stolons which have gradually become obliterated.

Already at the base a lateral branch comes off on one side, then follow, higher up, two other lateral branches at wide distances on two opposite sides. They come off at right angles from the stem but bend somewhat upwards in their course, they also diminish in size from the base to the apex, like the main stem.

The outer covering of the stem and branches is soft and flabby, and not calculated to give firmness to the colony. One recognises therein, with the aid of a lens, numerous irregularly disposed needle-shaped spicules. From the stem and branches spring, in like manner, short, stiff, secondary branches, coming off at right angles. These either again give off small lateral twigs, or divide directly into two or three short, divergent

twigs. They are placed at wide intervals from one another, and their ramification is so loose that the stem and branches can everywhere be distinctly made out. The distance between the individual branches is from 5 to 8 mm.

Each twig on an average bears three, seldom more, polyps. The polyps have long peduncles and diverge from one another from the base upwards. They measure up to 3 mm. in length, the diameter of a head being 1 mm. A short, fine spicule surmounts each head for a distance of, at most, 0.5 mm.

The outer covering of the stem contains numerous spicules of various shapes, loosely scattered in the thin mesoderm. In the outermost layer there are variously shaped spicules, the prevailing form being that of a spiny club, frequently with divergent processes at its base, or double structures appear which lead to the formation of irregular crosses and stars. Branched spiny spicules occur abundantly over the surface of the ectoderm and give it a granular character. These structures measure on an average 0.1 to 0.18 mm. Amongst these lie fine spindles covered with upright spines, 0.3 to 0.6 mm. long and 0.03 to 0.04 mm. in diameter, and long club-shaped spicules, 1 mm. in length. All these spicules are scattered amongst one another in different directions.

In the little branches and twigs, on the contrary, there are developed only fine, slightly curved spindles, packed close together and longitudinally arranged. These are covered with fine lateral spines, and are often rounded off at one or both ends; size, 1.87 by 0.08; 1.0 by 0.07; 0.65 by 0.05; 0.4 by 0.025 mm. The polyp heads are surrounded at the base by a zone of spicules, from which arise eight groups, each composed of two long needle-shaped spicules converging towards the outside. These form eight rays around the margin, starting from the bases of the tentacles. These latter fold themselves together over the head and thus form a kind of operculum. Each of these spicules is pointed at the free end, rounded off and bent round at the other, and covered with fine lateral spines; length 1.0 mm., diameter at the thick end 0.05 mm.

The tentacles are covered with thickly placed, transversely arranged, curved spicules, which are somewhat flattened on two sides and toothed on the margins; length 0.12 mm., diameter 0.02 mm.

The colour of the stem and branches is white, that of the twigs and polyps a bright and dark yellow ochre.

*Habitat*.—Station 192, off the Ki Islands; lat. 5° 49' 15" S., long. 132° 14' 15" E.; depth, 140 fathoms; bottom, blue mud.

*Spongodes rhodosticta*, n. sp. (Pl. XXXVIA. figs. 4a. 4b).

The straight, upright stem, is fixed at the base in the sand by means of root-like stolons, it gives off from all sides, at a distance of about a quarter of its height, longer and shorter branches which, quickly ramifying, terminate at the end in divergent polyps. The

polyps are surmounted by spicules; the heads, placed at wide distances from one another, are distinguished from the white network of branches by means of their orange colour.

Height of the colony in the larger specimen 130 mm., in the smaller 74 mm.; length of the barren stem in the larger specimen 30 mm., in the smaller specimen 12 mm.

The barren portion of the stem is cylindrical and provided at the base with numerous stolons, which, partly ramified, anchor the colony in the sandy mud. The outer covering is fairly tough and somewhat granular towards the outside, less flabby than in the preceding species. After a slight constriction the stalk is continued into the tall, upright stem, which gives off from all sides larger and smaller branches, and bifurcates at the end into two branches diverging from one another at an obtuse angle. The remaining branches come off from around the stem in an indistinct spiral, but the more strongly developed branches, of which there are four or five, come off chiefly from two opposite sides. These behave like the main stem and give origin to spirally arranged, smaller, secondary branches.

The large branches attain a length of 30 to 45 mm., the smaller ones and the secondary branches 6 to 10 mm. They stand at right angles to the stem. The secondary branches, which are frequently somewhat flattened, soon divide into three or four twigs, each of which bears three or four polyps. The polyps have long peduncles and are placed at acute angles to one another. Usually one polyp has a longer stalk than its neighbours, above which it projects. Flattening takes place also in the twigs, and on many branches it is carried to such an extent that the twigs fuse together and form a fan-like, indented-leaf, bearing the pedunculate polyps on its margin. The polyps may be 1 to 4 mm. in length, while the diameter of the polyp heads is 1 mm. In the older and larger colony, where also the tendency of the twigs to form fans is more strongly marked, the stem is almost completely concealed by the luxuriant branching, a condition which is less obvious in the smaller specimen. The straight twigs, and especially the peduncles of the polyp heads, are stiff and very rigid, so that they easily break off, while the stem and the large branches have a more flabby consistence.

The spicules which occur in the barren portion of the stem agree very closely in shape with the corresponding spicules of the same portion of the preceding species. They are spiny clubs, placed on a cross-shaped basal portion. This portion has four rays, placed sometimes at right angles and sometimes more obliquely to one another. The rays are provided at the end with spiny processes, and sometimes also one ray is more especially developed. The distance between the apices of two rays reaches, on an average, 0.12 mm. A spiny club projects at right angles from the point where they cross one another; it is usually flattened in one direction, and its height reaches 0.1 mm. The cruciform basal pieces are placed close together and form quite a thick network of calcareous substance, from which the spiny needles project above the surface in the form of rough warts.

In the polyp-bearing portion of the stem occur, in addition to these spicules, irregularly scattered spindles; these are continued into the branches and twigs, where they are longitudinally placed, and where also they are closely packed, and give rise to the brittle consistency of the twigs. In the peduncles of the polyp heads one spindle is especially developed; this spindle projects above the head, which appears to lie laterally upon it. These spicules are slender, spindle-shaped, slightly curved, either simply or *f*-shaped, and covered all over with sharp spines; size, 0·8 by 0·05 mm.; 0·7 by 0·05 mm.; 1·5 by 0·05 mm.; 0·9 by 0·04 mm.; 3·0 by 0·08 mm.; 3·8 by 0·18 mm.; 4·0 by 0·1 mm.

The spicules which project above the heads measure up to 4·0 by 0·25 mm. The polyp heads show at their base a number of peripherally disposed spindles, from which eight project, sticking up from the base above the margin like teeth. They are supported at their origin by smaller spindles which converge towards them. These spicules are thickened at the base, pointed towards the outside, and covered with outwardly directed spines resembling the teeth of a saw; size, 0·9 by 0·07 mm. There are also developed at the base of the tentacles, two long spicules converging upwards; these measure up to 1 mm. in length, and when the tentacles are folded together are themselves laid together over the mouth. The tentacles themselves are covered with small, curved, scale-like, transversely arranged spicules, which attain a size of 0·15 by 0·017 mm.

The colour of the colony, stem, branches, twigs, and polyp peduncles, is white; that of the polyp heads orange-red.

*Habitat*.—Station 192, off the Ki Islands; lat. 5° 49' 15" S., long. 132° 14' 15" E.; depth, 140 fathoms; bottom, blue mud.

*Spongodes cervicornis*, n. sp. (Pl. XXXVI. figs. 2*a*, 2*b*).

This species closely resembles the preceding one in habit. The main stem is attached to the substratum, on which it grows by means of a broad foot-plate. Already close above the base it gives off single larger branches, which like the main stem give off at right angles on all sides sparsely ramified secondary branches, on whose terminal twigs the polyps are placed on long peduncles. The ramifications in this case are, nevertheless, somewhat different from that of the preceding species, in that the polyps come off, not only from the ends of the twigs, but also from the sides, and are surmounted by long spicules. The twigs are less rigid, rather soft and yielding. The entire colony is flabby and shrub-like from the presence of numerous larger branches.

Height of one colony,	.	.	.	.	.	100 mm.
Diameter of the main stem near the base,	.	.	.	.	.	18 "
Length of one of the larger branches,	.	.	.	.	.	40 "
Length of the smaller secondary branches,	.	.	.	.	.	8-12 "



The stem, which is attached to the rocky substratum by means of a broad base and shows no development of stolons, gives off on all sides, and at tolerably wide distances from one another (viz., 5 to 8 mm.), larger branches, which resemble the main stem, and small branchlets which surround the stem and larger branches equally. These branchlets are flattened, from the base outwards, in a direction at right angles to the long axis of the colony. They are sparsely ramified in one plane, and each usually divides into two or three twigs diverging from one another at obtuse angles. From the sides and apex of the twigs the polyps arise, they are placed on long peduncles and surmounted by spicules.

One twig thus bears from five to eight polyps, which sometimes come off at right angles and sometimes radiate, at the apex, in a fan-like manner. The flat twigs sometimes fuse together, especially towards the base of the stem, so as to form serrated folia, whose margins are covered with divergent polyps. Or the branches and twigs may be fused together immediately above the base so as to form a collar-like pad, convex downwards, from which the divergent polyps originate. The branches and twigs are soft and yielding, and the entire colony has a spongy consistence. The stem and branches are covered with spindle-shaped spicules, arranged irregularly and crossing one another. In the branchlets and twigs they are arranged in longitudinal series, and they are continued into the peduncles of the polyps, of which one spicule projects like a spine above each polyp head, for a distance of 1 mm. at the most. These spicules are partly straight and partly *f*-shaped, and they are covered with small, sharp spines; their length varies from 0·8 to 5·0 mm.; the latter occurring especially in the polyp-peduncles. Length to breadth, 1·3 by 0·032 mm.; 4·0 by 0·09 mm.; 5·0 by 0·12 mm.; 5·0 by 0·013 mm.

The polyp heads are small, measuring 0·8 mm. They have at their bases a number of peripherally arranged spicules, from which eight larger ones arise, surmounting the margin of the calyx. These spicules are truncated at the base, pointed at the free end and provided with small, straight spines; size, 0·58 by 0·03 mm. Some convergent spicules at the base of the tentacles form a kind of operculum to the calyx. In the tentacles there occur small spicules. The smaller spicules of the polyp heads measure 0·36 by 0·025; 0·2 by 0·033; 0·3 by 0·018 mm.

The colour of the colony is white, the twigs and polyps at the base and over half the extent of the colony are purplish-red.

*Habitat*.—Tahiti; depth, 30 to 70 fathoms.

The description of the following species will make this section more complete:—

*Spongodes semperi*, Studer.

*Spongodes semperi*, Studer, Ann. and Mag. Nat. Hist., ser. 6, vol. i. p. 69.

A thick, cylindrical, barren trunk, whose base is fixed in the sand by means of stolons. It gives off from its upper end, which is bounded by a circular fold covered on

the margin with polyps, a number of conical branches. These branches together form a rounded head, the middle branches being higher than the lower ones. Each branch is covered with relatively large polyp heads, each of which is surmounted by a bundle of spicules. These heads are arranged on the branches in close spirals, the branches thus acquiring the form of spikes. The colony is rigid, the wall of the trunk is encrusted with large spindle-shaped spicules.

Colour in spirit, greyish-white.

*Habitat*.—Philippine Islands; collected by Professor Semper.

*Spongodes glomerata*, Studer.

*Spongodes glomerata*, Studer, Ann. and Mag. Nat. Hist., ser. 6, vol. i. p. 70.

The colony forms a low stock, which appears to be divided into several spherical lobes. It is of a whitish colour with reddish polyp heads. Height 12 mm., breadth 45 mm. The short stem divides shortly above the base into diverging branches, which are covered from the commencement with polyp-bearing lobules. These arise from a very rapid ramification of the twigs which bear bundles of polyps at the ends. The lobules are spherical, 6 to 9 mm. in diameter, and contain up to twenty polyp heads, each surmounted by a stout spicule 2 mm. long. The folded tentacles, armed with small spicules arranged *en chevron*, form an eight-lobed operculum. The consistence of the whole is soft and yielding. The species is most nearly related to *Spongodes savignyi* (Ehrbg.), which also it most resembles in external habit.

*Habitat*.—Japan; collected by Dr. Döderlein.

*Spongodes punicea*, Studer.

*Spongodes punicea*, Studer, Ann. and Mag. Nat. Hist., ser. 6, vol. i. p. 70.

An upright, branched colony, 50 mm. high and 40 mm. in diameter, with a short stem and a lobose head crowded with polyps. Colour purplish-red with yellowish-white polyp heads. The stem rises from an incrusting base. It has a thickness of 10 mm., and a height of 10 mm., and then divides into thick branches which, after a short course, terminate in somewhat flattened twigs. Previous to the final ramification they give off also several small branchlets, which come off at right angles. The ramification of the terminal twigs, which are about 2 mm. thick, takes place in a corymbose manner, in which the three to six terminal twigs bear the polyp heads laterally, the polyp heads being surmounted by bundles of spicules. The terminal twigs diverging, form separate lobes 5 to 10 mm. in diameter, which bear ten to twenty calyces. The two large spicules at the base of the tentacles converge  $\Lambda$ -like and form an operculum.

*Habitat*.—Japan; collected by Dr. Döderlein.

*Spongodes pumilio*, Studer.

*Spongodes pumilio*, Studer, Ann. and Mag. Nat. Hist., ser. 6, vol. i. p. 70.

The colony forms a low, lobose mass, 25 mm. high and 65 mm. broad; of a whitish colour with red polyp heads surmounted by bundles of silvery white spicules.

A short trunk divides near its base into several thick branches which are horizontally expanded. Each of these branches divides at the end into several divergent twigs, first, however, giving off lateral twigs on two sides. The terminal twigs speedily divide into little twigs which are arranged in a corymbose manner and bear bundles of polyps, in which each calyx is surmounted by a spicule 2 to 2.5 mm. in length. The heads are red, the lateral bundles of spicules white. In each bundle of polyps one polyp appears to be more strongly developed than the others, and to project above them.

*Habitat*.—Enoshima, Japan; collected by Dr. Döderlein.

*Spongodes rigida*, Studer.

*Spongodes rigida*, Studer, Ann. and Mag. Nat. Hist., ser. 6, vol. i. p. 71.

The colony is a loosely-ramified, shortly pedunculate, head-like mass, of rigid consistence. The colour of the mass is dark purple, that of the polyp heads yellow. Height of the colony 33 mm., diameter 35 mm. The short, cylindrical stalk divides at a height of 12 mm. into a number of branches coming off on all sides. The branches are directed in part horizontally outwards, in part obliquely upwards, and bear at the end divergent twigs which divide in a corymbose manner into the polyp-bearing terminal twigs. Each of the latter bears a bundle of three to five polyps, whose heads are supported by a spicule 2 to 3 mm. in length. Each head possesses an eight-radiate operculum, composed of yellow spindles, 0.25 mm. in length. Numerous spindles occur embedded throughout the entire mesoderm, which thereby acquires a firm, rigid condition.

*Habitat*.—Japan; collected by Dr. Döderlein.

*Spongodes coccinea*, Studer.

*Spongodes coccinea*, Studer, Ann. and Mag. Nat. Hist., ser. 6, vol. i. p. 71.

The colony forms an irregular, lobose mass, placed on the end of a short barren stalk which has a leathery consistence. The head is thickly covered with polyps and is of a dark carmine-red colour. Height of the colony 45 mm. Diameter 45 mm. Length of the stalk 17 mm.

The ramification takes place in such a fashion that the main stem divides into a few (four) large, flat branches, speedily giving off along their course and from their ends smaller secondary branches, which divide into smaller secondary and terminal twigs.

These bear bundles of from four to six polyp heads. These terminal lobules are united with the others into larger groups, and these again into four lobes which correspond to the four main branches. The polyp heads are small; the dorsal bundle of spicules is only slightly developed, and projects only slightly above the head. Eight groups of spicules form an opercular cover.

*Habitat*.—Enoshima, Japan; collected by Dr. Döderlein.

*Spongodes flabellifera*, Studer.

*Spongodes flabellifera*, Studer, Ann. and Mag. Nat. Hist., ser. 6, vol. i. p. 72.

The colony forms an upright stem, 73 mm. high, from which, at a height of 30 mm. and upwards, branches come off on all sides. These, speedily ramifying, form at the end small umbels in which each terminal twig bears a bundle of three to eight polyps, but here and there also single polyps occur. The lowermost branches are flat and their twigs are fused together; they thus form fan-shaped, serrated folia whose margins are beset with rows of polyps. The ramification is loose, so that it can easily be made out everywhere. The polyp heads are pedunculate, free from one another for a short space, and slightly surmounted by bundles of spicules. The heads are surrounded by eight groups of spicules arranged *en chevron*, which project like teeth above the margin.

Height of the sterile stem, . . . . .	30 mm.
Diameter, . . . . .	16 „
Height of the polyp-bearing portion, . . . . .	43 „
Transverse diameter of the same, . . . . .	35 „

The colour of the polyp umbels is dark fleshy-red, the stem and branches are white.

*Habitat*.—Enoshima, Japan; collected by Dr. Döderlein.

*Spongodes klunzingeri*, Studer.

*Spongodes klunzingeri*, Studer, Ann. and Mag. Nat. Hist., ser. 6, vol. i. p. 72.

*Spongodes ramulosa*, Klunzinger, Korallenthiere des rothen Meeres, p. 37, pl. iii. fig. 2.

*Non Spongodes ramulosa*, Gray, Proc. Zool. Soc. Lond., 1862, pp. 28, 29, figs. 5, 6.

After comparison of the typical specimens of *Spongodes ramulosa*, Klunzinger, from the Red Sea, which Professor von Martens most kindly placed at my disposal from the Berlin Museum, with specimens of Gray's species, it became evident that the two are specifically distinct. Hence the name *Spongodes klunzingeri* might be adopted for the species described by Klunzinger.

## REVIEW OF THE SPECIES OF SPONGODES HITHERTO DISTINGUISHED.

A. *Spicatæ*.

1. *Spongodes digitata*, n. sp. ; Philippines.
2. „ *spicata*, n. sp. ; Philippines.
3. „ *semperi*, Studer ; Philippines.
4. „ *nephtyæformis*, n. sp. ; Admiralty Islands, 25 fathoms.

B. *Glomeratæ*.*a. Lobatæ.*

5. *Spongodes carnea*, n. sp. ; Tahiti, 30 to 70 fathoms.
6. „ *studer*, Ridley ; M'Clure Gulf, New Guinea, Queensland, Australia.
7. „ *cælosia*, Lesson ; New Guinea.
8. „ *arborescens* (Dana), Verrill ; Fiji.
9. „ *hemprichii*, Klunzinger ; Red Sea ; Torres Strait (?).

*β. Capitatæ.*

10. *Spongodes savignii*, Ehrenberg ; Red Sea.
11. „ *glomerata*, Studer ; Japan.
12. „ *punicea*, Studer ; Enoshima, Japan.
13. „ *capitata*, Verrill ; Hong Kong, 1 fathom.
14. „ *pumilio*, Studer ; Enoshima, Japan.
15. „ *rigida*, Studer ; Enoshima, Japan.
16. „ *coccinea*, Studer ; Enoshima, Japan.

*γ. Umbellatæ.*

17. *Spongodes spinosa*, Gray ; Torres Strait, 3 fathoms ; Port Denison, Queensland ; New Guinea.
18. „ *macrospina*, n. sp. ; Torres Strait, 8 to 10 fathoms.
19. „ *florida* (Esper) ; Samboangan, 10 fathoms ; Philippines ; Port Jackson, Australia.
20. „ *gigantea*, Verrill ; Hong Kong, 1 fathom.
21. „ *corymbiflora*, n. sp. ; Torres Strait, 28 fathoms.
22. „ *umbellata*, n. sp. ; Torres Strait, 3 to 11 fathoms.
23. „ *dendrophyta*, n. sp. ; Philippines, 20 fathoms.
24. „ *anguinea*, n. sp. ; Philippines, 10 fathoms.

25. *Spongodes bicolor*, n. sp.; Torres Strait, 3 to 11 fathoms; Samboangan, 10 fathoms.  
 26. „ *collaris*, n. sp.; Arafura Sea, 140 fathoms.  
 27. „ *flabellifera*, Studer; Enoshima, Japan.  
 28. „ *spinulosa*, Gray; Indian Ocean.  
 29. „ *heterocyathus*, n. sp.; Torres Strait, 3 to 11 fathoms.

C. *Divaricatæ*.a. *Umbellatæ*.

30. *Spongodes coronata*, n. sp.; Torres Strait, 8 to 10 fathoms.  
 31. „ *pustulosa*, n. sp.; Tahiti, 30 to 40 fathoms.  
 32. „ *monticulosa*, n. sp.; Torres Strait, 28 fathoms.  
 33. „ *divaricata*, Gray; New Guinea.  
 34. „ *ramulosa*, Gray; Bellona Reef, 17 fathoms.  
 35. „ *klunzingeri*, Studer (*ramulosa*, Klunz.); Red Sea.

β. *Laxæ*.

36. *Spongodes laxa*, n. sp.; Arafura Sea, 140 fathoms.  
 37. „ *rhodosticta*, n. sp.; Arafura Sea, 140 fathoms.  
 38. „ *cervicornis*, n. sp.; Tahiti, 30 to 40 fathoms.  
 39. ? „ *unicolor*, Gray; Bellona Reef, 17 fathoms.  
 40. „ *gracilis*, Verrill; Loo Choo Islands.

## Subfamily 2. SIPHONOGORGINÆ.

In this subfamily we include all the Nephthyidæ in which the partition walls, bounding the canals of the stem and branches, are rigid and filled with spicules. Hence the species of this subfamily have a firmer and more rigid consistence than the species of Spongodinæ exhibit. The general form of the colony sometimes still recalls species of *Nephthya* and *Ammonothea*, and sometimes, in the most extreme cases, it calls to mind species of the Gorgonidæ. The thicker the spicules are packed in the internal dividing walls of the canals the more can the colony develop in height and in the extent of its ramifications, which thus allows of an advantageous arrangement and distribution of the polyps.

The subfamily is understood here in a wider sense than Kölliker's subfamily Siphonogorgiaceæ, in that we include here quite new forms which would not come within the

narrow limitation of Kölliker's definition. Several of the genera included by us exhibit again a near relationship to the Alcyonidæ, especially to *Alcyonium*. This holds good of *Paranephthya* as regards the condition of the polyp tubes, and of *Chironephthya* as regards the structure of the polyps, which exhibit a distinct calyx, and as regards the distribution of the polyps on the branches.

Genus *Paranephthya*, n. gen.

Upright, ramified colonies, on whose terminal twigs the polyps are placed in thick clusters. The polyps are not retractile. The canals of the colony are narrow and divided from one another by relatively thick partition walls which contain scattered spicules. The outer covering is smooth. The spicules of the outer covering and of the polyps, as well as those of the canal walls, are foliaceous and spiny clubs, with various outgrowths.

The fact that the spicules are still developed in rather small numbers in the partition walls of the canals brings this genus near to the preceding division. As regards the form and build of the colony it stands nearest to *Duva*, Dan. and Kor., and certain forms of *Nephthya*.

The canal-system in the stem and branches is peculiar and different from that of all the representatives of the division Spongodinæ. In the branches there are numerous fine canals, separated by thick dividing walls from one another; these canals are still more numerous in the stem, whose transverse section appears like a fine sieve. Hence the stem has a much more compact character than in the Spongodinæ, in which it is penetrated by less numerous and wider canals.

In the arrangement of the canals no definite boundary can be recognised. They are direct prolongations of the digestive cavities of the polyps, which are thus continued directly into the stem without alteration of their width.

The polyps are club-shaped, not retractile. In repose the tentacles are simply laid together over the mouth. In the contracted condition they bend towards their support, as in *Eunephthya* and as in the Primnoidæ. The spicules are very uniformly developed as foliaceous and spiny clubs, which lie close together. When in spirit the stem, branches, and polyps appear smooth; when dried the polyps in particular acquire a finely granular surface, which appears scaly when slightly enlarged.

The most nearly related genus is *Ammonothea*, Sav.

*Paranephthya capitulifera*, n. sp. (Pl. XXXVI A. figs. 1a, 1b; Pl. XLII. fig. 8).

The upright stem arises from a broad base growing over a fragment of coral. Gradually diminishing in size it gives off on different sides a number of irregularly

distributed, larger and smaller, short, stout, erect branches. These break up, either directly or at the end of other ramifications, into a number (three to six) of short twigs, which are thickly covered with polyps arranged in quincunces. The bodies of the polyps curve inwards in death, and cover each other like tiles. These terminal branches thus form polyp-bearing heads or short, conical clusters, of which those belonging to one branch stand close together. The main stem behaves at the end like the branches and secondary branches.

Height of the colony, . . . . .	65 mm.
Diameter of the base, . . . . .	25 „
Diameter of the main stem before the branches come off, . . . . .	18 „
Length of one of the larger branches, . . . . .	24 „
Diameter of the same, . . . . .	12-14 „
Length of a cluster, . . . . .	6 „
Diameter at the base of a cluster, . . . . .	4 „

The habit of the colony is completely that of *Nephtya chabrolii*, Aud., with which it might be easily confounded on a superficial examination. The greater toughness of the stem and branches, which have a much firmer consistence internally, and the homogeneous character of the outer covering in the stem and polyps, enable one, however, to recognise a distinction even with the unassisted eye. The closely crowded, club-shaped polyps, which are curved inwards towards the axis of the clusters, show at the end eight folds, the expression of the folded tentacles. They measure up to 2 mm. in length and 1 mm. in diameter at the tentacular portion. Young polyps arise between the old ones over the whole cluster. The canals in the smaller branches are narrow and very numerous; in the axis of one cluster there are forty to fifty, having a diameter of 0·3 to 0·5 mm. The thickness of the dividing walls reaches 0·1 mm. In the main stem the canals may be counted by hundreds, with a maximum diameter of 0·5 mm. The spicules are small, closely placed, foliaceous and spiny clubs. The broader portion of the spicule, which in the polyps projects above the surface, consists of a foliaceous expansion, flattened in one plane. This is supported by three stout divergent ribs, which project marginally like spines. There often comes off from the middle of the foliaceous expansion, in a vertical plane, a lateral expansion. The base exhibits three divergent, often branched, root-like processes.

The height and breadth of these spicules, measuring by breadth the transverse diameter of the foliaceous expansion, are as follows:—0·06 by 0·09; 0·08 by 0·068; 0·08 by 0·09; 0·06 by 0·1 mm.

The colour of the colony in alcohol is yellowish-white.

*Habitat*.—Samboangan; beach.



Genus *Scleronephthya*, n. gen.

The stem is upright, branched; the surface, branches, and twigs bear scattered polyps, which collect together in dense groups on the terminal twigs, and completely cover them. The canal-system consists in the main stem of numerous narrow canals, divided by thick partition walls filled with spicules. The spicules are large, spiny spindles, which form a thick coat of mail around the polyps, and are continued and arranged, *en chevron*, into the bases of the tentacles, which latter form a kind of operculum over the oral region. Beneath the bases of the tentacles the spicules form a distinct collaret.

In the shape and armature of the polyps this genus comes near to *Nephthya*, but the condition of the stem and branches brings it closer to *Siphonogorgia*, Kölliker. One distinguishes a more compact outer covering, and a central mass penetrated by canals, which is thickly filled with spicules. The canals are irregularly polygonal in section, and are absent from the centre of the stem, so that here the connective tissue filled with spicules forms a kind of irregular axis. The stem and branches acquire thereby a tough, compact consistence; neither in spirit nor in the dry condition do their walls collapse, whence they may be distinguished at the first glance from those of the true Spongodinae.

*Scleronephthya pustulosa*, n. sp. (Pl. XXXVIA. figs. 2a, 2c).

The upright colony arises from a slightly expanded base, first in the form of a main stem. This after a short course gives off, mainly on two sides, rather large branches rising upwards at acute angles, while on both the other sides only small branches come off irregularly. Both the main stem and the branches divide at the end into two or three short, diverging, secondary branches. In addition to these the branches also give off at right angles along their course small secondary branches. Quite short terminal twigs, thickly covered with polyps, arise at various intervals from the secondary branches, forming, together with their polyps, roundish heads. Polyps, partly isolated and partly in groups of three and more, also arise here and there at wide intervals directly from the main stem and branches, in such a manner that the greater part of the branches and of the stem appears naked. The polyps have a wart or club-like shape and project at right angles from their support.

Height of the colony,	.	.	.	.	.	85 mm.
Diameter of the main stem at its base,	.	.	.	.	.	16 "
Diameter of the main stem in the centre,	.	.	.	.	.	9 "
Length of one of the larger branches,	.	.	.	.	.	32 "
Length of a polyp-bearing twig,	.	.	.	.	.	4-5 "
Diameter of the same,	.	.	.	.	.	4 "
Length of a polyp,	.	.	.	.	.	1 "
Diameter of the same,	.	.	.	.	.	1 "

The stem and branches are stout, fragile, and quite inflexible; their surface has a rough granular character. The scattered polyps cause them to appear as though covered with warts. Even the terminal twigs do not show the cluster-like form found in the preceding genus, for the polyps everywhere project stiffly from the base, and are distinctly separated from one another. The canals in the stem are very numerous, and very irregular, being angular or oval, or slit-like in section. Their diameter varies from 2 to 0.8 mm. The partition walls which divide them increase in thickness from the outside towards the inside, attaining as much as 1 mm. in diameter. In the axis of the stem these partition walls unite together to form a central portion, which is very irregular in section. In the branches the canals are relatively wider and less numerous; there are eight in a slender branch, 4 mm. in diameter; they are radially arranged and still contain mesenterial folds on which ova are developed.

The spicules are wartv spindles, sometimes thickened at one end, frequently simply curved or *f*-shaped, surrounded by blunt, vertical warts.

In the calyces large *f*-shaped spindles are arranged in obliquely ascending rows, in such a manner that one spicule frequently extends half round the wall. At the base of the tentacles they are peripherally disposed and form a kind of collaret. In the bases of the tentacles, which when folded together cover the oral region forming a kind of operculum, small, spiny, somewhat flattened spicules occur, arranged *en chevron*. Small spicules also occur everywhere between the large spindles, filling up the intervals. Size of the spicules—in the branches and twigs 1.14 by 0.1, 0.5 by 0.05 mm.; in the polyps 0.4 by 0.025 mm, 0.54 by 0.08 mm.; in the collaret 0.25 by 0.025 mm.; small spicules 0.08 by 0.03 mm.; in the tentacles 0.09 by 0.03 mm.

Colour in alcohol, brownish-grey.

*Habitat*.—Station 208, lat. 11° 37' N., long. 123° 31' E.; Philippine Islands; depth, 18 fathoms; bottom, blue mud.

#### Genus *Chironephthya*, n. gen.

Colony rigid, upright, ramified. The ascending barren stem gives off after a longer or shorter course, stiff, finger-like branches, which either remain simple or give off a few stout secondary branches. The polyps arise at wide intervals along the whole extent of the branches, at the apex they are somewhat more crowded. They consist each of a calyx, which is pressed against the branch, a retractile œsophageal portion, and a tentacular portion which is provided at the base with a collar of spicules. The bases of the tentacles, armed with spicules, form a conical, quasi operculum.

In the ectoderm of the stem and branches there are a number of large spicules lying close together, and the same applies to the dividing walls of the canal-system, so that the entire colony acquires a rigid brittle consistency. In the slender branches the canals are

few in number (generally four) and wide; in the stem they are narrower and more numerous, and separated from one another by thick walls.

This genus comes nearest to *Siphonogorgia*, Kölliker, but is essentially distinguished by the fact that the polyps occur along the entire course of the branches, and are less retractile. The habit of the colony is more suggestive of *Nephthya*.

*Chironephthya dipsacea*, n. sp. (Pl. XXXVII. figs. 1, 1a).

The colony consists, in the perfect condition, of a tall, straight, ascending stem, whose base spreads over a mass of agglutinated sand. A few branches arise first from the upper third, becoming gradually pointed towards their ends; these come off sparsely and at varying angles, they are partly simple and partly provided with secondary branches. Especially in the lower third of the branch-bearing portion there arise short, flat branches, which, after a short course, radiate into numerous secondary branches, and these may again give off twigs. The terminal portions of the stem, branches, and secondary branches are covered with polyps, which are placed at wide intervals from one another and exhibit a spiral arrangement. Only towards the apices of the twigs are the polyps more thickly placed, at the apex itself there are usually two or three close together. The polyps exhibit a distinct calyx, which is directed obliquely upwards on the branches, and a well-marked tentacular portion. In the branches the canals are wide; at the base of each branch there are four, radially arranged. In the barren stem they are more numerous, up to the number of sixteen; they are of different widths, and arranged radially around a central axis. The thickness of their dividing walls gradually increases from above downwards.

Height of a colony, . . . . .	130-150 mm.
Height of the barren stem, . . . . .	90-95 „
Diameter of the stem, . . . . .	10 „
Length of an unramified branch, up to . . . . .	38 „
Diameter of the same at the base, . . . . .	4-5 „

The basal portion is present only in one specimen. It forms a flat overgrowth upon a mass of agglutinated sand, which it also surrounds laterally. At the margin it is divided into lobes and stolon-like processes. It passes gradually into the stem, which remains of nearly the same thickness up to the branches. The stem is oval or irregularly angular in transverse section, but generally compressed on one side; its consistence is rigid, feebly flexible and brittle. Its wall is incrustated with closely packed, longitudinally arranged spicules, which lie in two or three layers in the mesoderm, and give to the latter the character of a firm layer around the internal canal-system. At its branch-bearing portion the stem expands somewhat, but gradually diminishes towards the blunt

apex as the branches are given off. Its terminal portion is in no way distinguishable from a lateral branch. The lowermost branches are still abundantly ramified, and project at right angles from the stem. They are short, flattened branches, which radiate into several stiff, finger-shaped secondary branches, which may bear still slenderer twigs coming off at acute angles. The upper branches are generally simple; they seldom bear twigs, and are directed upwards at acute angles. The branches and twigs are stiff and very fragile, being incrustated with large spindle-shaped spicules.

The polyps stand at wide intervals from one another, and are directed obliquely upwards; they measure 1 to 1.5 mm. in length, and the distances between them measure from 3 to 4 mm. The apices of the twigs are occupied by from one to three polyps, which are closely crowded together.

The spicules of the stem and branches are usually curved or slightly *f*-shaped spindles, which are somewhat blunted at both ends and thickly surrounded with blunt vertical warts. In the stem they have an average length of 1 to 2 mm., with a diameter of 0.05 to 0.15 mm. In the branches and twigs they form longitudinal bands, measuring 2.5 to 3 mm. in length and 0.17 to 0.29 mm. in diameter. The spicules range in colour from white to yellow; between them are embedded smaller red or yellow spicules, usually straight, and measuring 0.71 by 0.03, 0.67 by 0.04 mm.

In the polyps a calicular portion may be distinguished, it is appressed to the stem and composed of longitudinally arranged, yellowish spindles; it does not rise up sharply from the coenenchyma. The tentacles are folded together over the mouth, and form a conical tentacular operculum; beneath them is a broad collar of spicules arranged in a circle, which extends for some distance up the oesophageal portion. It consists of curved, spiny spindles of a purplish-red colour, measuring 0.2 by 0.03 mm. In the bases of the tentacles, which form the operculum, the spicules are arranged in a  $\Lambda$ -like manner, with the apices directed towards the distal end. They measure 0.12 by 0.017 mm.

The stem and branches are yellow to reddish yellow, especially at the base. The polyps outside of the calyx are purple.

In a younger colony the barren stem is markedly shorter, and about the same size as the branch-bearing portion.

*Habitat*.—Station 232, *Hyalonema*-ground, Japan; depth, 345 fathoms.

*Chironephthya scoparia*, n. sp.

The cylindrical stem gives off, even at a slight height, stiff, finger-like branches, which are directed obliquely upwards at acute angles, and some of which extend themselves to the apex of the stem. The branches are stumpy and gradually diminish in size towards the apex; they bear in turn sparse twigs, coming off at greater or less angles, and usually not more than two or three in number. The polyps have laterally appressed

calyces and conical tentacular opercula; they are scattered at wide intervals on the branches and twigs, and somewhat more crowded towards the apex; at the apex three stand close together, one of them forming the terminal portion of the twig.

Height of the colony, the apex being broken off,	. . . . .	83 mm.
Length of the barren portion of the stem,	. . . . .	16 „
Diameter above the base,	. . . . .	8 „
Diameter about the middle,	. . . . .	6 „
Length of the largest branch arising at a height of 16 mm.,	. . . . .	52 „
Diameter near the base,	. . . . .	4 „
Length of a twig,	. . . . .	12-18-22 „
Diameter of the end of a twig,	. . . . .	2-3 „

One may well compare the habit of the colony with that of a birch twig, but it does not agree with the latter in the flexibility of the twigs, for the consistence of the whole is brittle and fragile.

The main stem is nearly cylindrical and diminishes only slightly in size from the base towards the upper end. Its direction is somewhat crooked, the coming off of the larger branches especially causing it to bend out of its course.

The surface is thickly encrusted by numerous calcareous spindles, which form a thick layer. They are very irregularly arranged, transversely, vertically, and obliquely. In the branches and twigs they first assume a more longitudinal direction, and form, especially in the thinner twigs, regular longitudinal bands. The polyps form long-drawn-out spirals on the branches and twigs, in which the individual polyps are separated from one another by intervals of 3 to 4 mm. Thus on a twig 22 mm. long there are only ten polyps, four of which stand around the apex, three in a close spiral and the fourth constituting the apex. The polyps have each a short, laterally appressed calyx, composed of a crown of elongated spicules. An obtusely conical tentacular operculum is composed of spicules arranged in a  $\Lambda$ -like manner in the bases of the tentacles. Beneath the latter there is a broad collaret of curved spindles. The length of the retracted polyps is 1.2 mm. and their diameter is 1 mm.

The canal-system usually consists, in the twigs and branches, of four wide, radially arranged canals separated from one another by thick, rigid, dividing walls filled with spicules. The canals are more numerous in the stem, where the dividing walls sometimes have a considerable thickness. The spicules of the stem are stout spindles, frequently pointed at one end and blunt at the other. They are thickly covered with stout warts, which are branched at the end, or bear numerous small sharp tubercles. These spicules are seldom straight, generally they are slightly bent or bow-shaped, or one end is bent round at an angle to the remaining straight portion. Sometimes they are strongly thickened at one end and pointed at the other. They measure 3.5 by 0.3; 3.0 by 0.28; 2.0 by 0.33; 1.3 by 0.2 mm. In the calyx, where they project from the

cœnenchyma as longitudinally disposed spicules, the one end is usually blunt and the projecting end sharp; they measure 1 to 0.9 mm. in length by 0.1 mm. in thickness.

The collar below the origin of the tentacles consists of delicate, purplish-red, curved spindles, covered with fine, sharp spines, seldom further toothed. They measure from point to point 0.7 by 0.045; 0.67 by 0.08 mm.

In the tentacles the purple, rarely yellow, spicules are straight or very slightly bent; they are sharp at one end, blunt at the other, and covered with fine spines. Size, 0.54 by 0.03; 0.5 by 0.05 mm.

The colour of the stem, branches, and twigs is yellowish-white; the tentacular portion of the polyps is purple.

In the structure of the polyps the species shows a great similarity to the preceding, but is distinguished, apart from the ramification, especially by the stouter and differently arranged spicules in the stem.

*Habitat*.—Station 232, *Hyalonema*-ground, Japan; depth, 345 fathoms.

*Chironephthya crassa*, n. sp. (Pl. XXXVIII. fig. 3, from an imperfect specimen).

The stout main stem, which is attached by a membranous base, gradually diminishes in size and gives off, after only a short course, a few thick, simple branches arising at various angles. The main stem, like the branches, is covered, from the point of origin of the first twig upwards, with spirally arranged polyps placed at wide intervals from one another and more closely packed at its end. The polyps have large, obliquely projecting calyces, above which there rises a conical tentacular operculum. The polyps are considerably larger than in the two preceding species.

Height of a colony in which the apex is wanting,	.	.	.	69 mm.
Height of the barren portion of the stem,	.	.	.	20 "
Diameter of the stem above the base,	.	.	.	15 "
Diameter in the middle,	.	.	.	10 "
Length of the branches,	.	.	.	20 "
Diameter of the same,	.	.	.	4-6 "

The colony does not present quite the same rigid consistence as in the two preceding species. The stem and branches are hence somewhat shrivelled and collapsed in the specimens preserved in spirit, and the branches also show a slight flexibility. The barren portion of the stem is very thick, and after extending for only a slight distance it gives off at an acute angle a cylindrical branch. In its further course only a few (viz., five), more branches follow; these are all stout, unramified, and nearly cylindrical, diminishing only slightly in size towards the apex. The polyps commence to appear on the stem immediately after the giving off of its first branch; they are placed at distances of 4 to 2 mm. On the branches they form irregular spirals, which become closer towards the

apex. The end of the branch is occupied by one polyp, closely surrounded by a spiral of three or four others. The calyces of the polyps project obliquely from the base, and are freer than in the preceding species. The tentacular operculum appears conical and is more or less sunk into the calyx. The polyps measure 2 to 3 mm. in height, and the calyces are 2 mm. in diameter. The canal-system consists of wide canals bounded by relatively thin dividing walls filled with spicules.

In the barren portion of the stem the spicules are scattered crosswise and transversely; in the polyp-bearing portion they are longitudinally placed, and in the branches they form regular longitudinal bands.

The spicules are stout spindles, frequently straight or slightly *f*-shaped, thickly covered with stout warts, which bear at the end little spines, length 2 to 3 mm.; here are also more slender spindles, with more scattered warts; they measure 3.0 by 0.37; 2.5 by 0.32; 2.0 by 0.33; 0.9 by 0.3; 0.9 by 0.13; 0.5 by 0.05 mm.

The collaret consists of slightly curved spindles covered with small spines; size, 0.67 by 0.05; 0.54 by 0.05 mm.

In the tentacular operculum occur abundantly spined spicules, sometimes enlarged at one end and diminished at the other, which is directed towards the apex, and these sometimes have a recurved base. They measure 0.9 by 0.13 to 0.06; 0.7 by 0.05; 0.3 by 0.067 mm.

The colour of one specimen is purple on the barren portion of the stem; the remaining portion, as well as the branches and calyces, are yellowish, and the tentacular portion of the polyps is pale red. The spicules of the collar are purple, those of the tentacles yellow and red, each spicule generally parti-coloured. A second specimen is dark flesh-red, and the tentacular portion of the polyps purple.

*Habitat*.—Station 232, *Hyalonema*-ground, Japan; depth, 345 fathoms.

### Genus *Siphonogorgia*, K  lliker.

*Siphonogorgia*, K  lliker, Festschr. zur Feier d. funfundzwanzigj  hrigen Bestehens der physico-medicin. Gesellsch. W  rzburg, 1874, p. 18, Tab. i. fig. 6.

„ Klunzinger, Die Korallthiere des rothen Meeres, Alcyonarien, p. 48.

The interesting genus *Siphonogorgia* has been thoroughly and exhaustively described by K  lliker. The author found that the single species which he had examined, showed in its manner of growth a close relationship to the Gorgonid  ; he regarded it as a form intermediate between the Gorgonid   and Alcyonid  , and founded a new subfamily upon it, that of the Siphonogorgiace  , as “Alcyonaria intermediate between the *Gorgonid  * and *Alcyonid  *. Habit that of the *Gorgonid  *. Sarcosome hard, composed of many calcareous spicules and connective tissue. Polyps discoverable only on the ends of the smallest branches, contained within slightly projecting calyces, retractile. Digestive

cavities canal-like and elongated, penetrating the entire stock and found both in the twigs and stems. Only four of the septa enter into the elongated gastral cavities, namely those which bear the sexual organs and the long, narrow, mesenterial ridges. Sexual products contained within the elongated gastral tubes of the smallest branches."

"Genus *Siphonogorgia*, Kölliker, with much connective tissue in the sarcosoma, especially around the gastral tubes. Polyp calyces with slightly developed calicular opercula."

*Siphonogorgia mirabilis*, described by Klunzinger (*loc. cit.*) from the Red Sea, exhibits still more markedly the habit of the Gorgonidæ, but *Siphonogorgia squarrosa*, Kölliker and Studer, while retaining the essential characters of the genus, strongly recalls the Nephthyidæ. The canal-system is analogous, as is also the system of narrow nutrient canals ramifying between the polyp tubes. The relationship with the Nephthyidæ is still more easily effected through the new genus *Chironephthya*, so that it appears proper to give up the isolated subfamily of the Siphonogorgiaceæ, and to place the genus under the family of the Nephthyidæ. The diagnosis of Kölliker's subfamily then remains as the diagnosis of the genus; the subfamily Siphonogorginæ here created being understood in a much wider sense.

*Siphonogorgia godeffroyi*, Kölliker.

A specimen found only in fragments, which appear to belong to a young colony, may be referred to this species, so thoroughly described by Kölliker. It consists of a main stem from whose upper portion short branches come off on all sides. The barren portion forms half of the stem. The branches are covered with small, appressed polyp-calyces, within which the tentacles are sunk. In that the branches and twigs are still very short, and the greater portion of the same is occupied by polyps, the habit of the colony differs somewhat from that of the specimen described by Kölliker. But since the finer structure, spicules, canal-system, colour, &c., agree, we may refer the present specimen to the same species.

*Habitat*.—Station 232, *Hyalonema*-ground, Japan; depth, 345 fathoms.

*Siphonogorgia köllikeri*, n. sp. (Pl. XXIV. fig. 2).

An upright, ramified colony, whose main stem gives off short, blunt branches on two sides at angles of about 80 degrees. These branches are not further ramified, and they bear at the end a group of two or three polyps. Polyps also occur arranged spirally on the stem and branches. The polyps are placed obliquely to their support, the mouth being directed towards the end of the branches. They possess a tentacular operculum composed of spicules. The stem and branches are somewhat flattened in the plane of



ramification. The spicules are large, warty spindles, which form a thick layer in the cœnenchyma; smaller spicules lie in the dividing walls of the elongated polyp tubes. Unfortunately there are only fragments of this species present. (See Appendix.) These indicate a kind of colony formation which much recalls *Siphonogorgia mirabilis*, Klunzinger. The consistence of the whole is stiff and brittle, even in the fragments in spirits. In the largest fragment the main stem has a thickness of 2 mm. The length of a branch is 5 mm. and its thickness 1 mm.

The polyps are arranged spirally on the stem as well as on the branches. One can distinguish a calicular portion, which arises obliquely upwards on the stem, and whose outer wall is 0.8 mm. high. The tentacular operculum is withdrawn up to its margin. The distance between the individual polyps is 1.2 mm., towards the points of the twigs they press more closely together, and at their apices there are generally three close together, one of which occupies the centre. The entire cœnenchyma contains large, longitudinally arranged spindles, which lie close together so as to form a coherent layer. These are distinctly recognisable even with the unassisted eye. They are generally stout spindles, sometimes straight, sometimes simply curved and sometimes slightly *f*-shaped, with rounded ends, and thickly covered with large, erect, somewhat tubercular warts. They measure 1.2 by 0.2; 1.2 by 0.18; 1 by 0.12 mm.

Each calyx is surrounded by a crown of spindles, which stand upon the spicules of the cœnenchyma either vertically or obliquely (following the direction of the calyx). These spindles are slightly curved, usually sharp at both ends, and covered with smaller projecting warts. They measure 0.6 by 0.09; 0.48 by 0.08 mm. In the bases of the tentacles small spicules occur arranged in a  $\Lambda$ -shaped manner; these constitute an operculum which can be withdrawn beneath the margin of the calyx; they measure 0.2 by 0.025 mm. Beneath these there is a collaret formed of curved spindles arranged in a circle; these measure 0.23 by 0.025 mm.

The interior of the branches and of the stem is penetrated by canals, which are the prolongations of the gastral cavities of the polyps. In each branch three, seldom four, wider tubes are distinguishable, which are embedded in the axis. These are the elongated gastral cavities of the terminal polyps. They are clothed with endodermal epithelium, separated from that of the next tube only by a very thin layer of mesoderm.

Of the mesenterial filaments four extend to below the œsophageal tube of the polyp, two further, while two are prolonged still further as low ridges. On these are developed ova, which are met with even far below in the gastral cavity. Spermatozoa were never found, so that the species is probably diœcious. Towards the outside of the axial gastral cavity ova of small diameter occurred in greater numbers; these belonged to the lateral polyps. The canals are separated by thick layers of mesoderm, which thicken still more at the periphery, forming a layer in which the large spicules are embedded. In the mesoderm surrounding the canals are embedded smaller calcareous spicules, which are

sometimes rod-shaped and covered with thick spines, and sometimes spindle-shaped, bearing small warts. They measure 0·33 by 0·05; 0·38 by 0·033; 0·3 by 0·034; 0·38 by 0·08; 0·27 by 0·07 mm. The colour of the entire colony is bright coral-red.

The species may be readily distinguished from *Siphonogorgia mirabilis*, which is the one most nearly related to it, by the large spicules of the cœnenchyma, which are visible even to the unassisted eye.

*Habitat*.—Amboina.

### Family III. ALCYONIDÆ.

*Alyconidæ*, Verrill, Proc. Essex Inst., vol. iv. p. 348, 1865.

*Alcyoninæ retractiles*, Klunzinger, Die Korallthiere des rothen Meeres, p. 21, 1877.

The polyp colony is fleshy, forming sometimes a simple, at other times a more or less branched, mass, of which there can often be distinguished a basal or stem-like portion, sterile, and a capitular or head portion bearing the polyps.

The thick cœnenchyma surrounds the long polyp tubes, which are interconnected by a system of fine nutrient canals. The polyps are retractile within well-marked depressions in the cœnenchyma.

The polyps are sometimes dimorphic, the autozooids being for the most part sexual, with well-developed tentacles, the siphonozooids being rudimentary, but in some cases (*Anthomastus*) also sexual.

The spicules of the stem or sterile portion, when such exists, are larger, and often different in form from those of the capitular portion. The capitulum, when present, is mushroom-shaped or lobular.

Species of the following genera were found during the voyage :—

*Bellonella*, Gray.

*Alcyonium*, L.

*Sarcophytum*, Lesson.

*Lobophytum*, Marenz.

*Anthomastus*, Verrill.

### Genus *Alcyonium*, Linn.

*Alcyonium*, Linn., Syst. Nat., ed. x. p. 803 (*pars*).

„ Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 114 (*pars*).

„ Klunzinger, Die Korallthiere des rothen Meeres, p. 21 (*pars*).

We venture, though in opposition to the views of Klunzinger and others, only to include in this genus those fleshy Alcyonids found in the temperate and cold seas, referring those found in the tropics to the genus *Lobularia*.

The genus may be known by the fleshy consistency of the colony, the large size of the polyps, and the spindle-shaped spicules, which are not very densely distributed in the cœnenchyma.

*Alcyonium antarcticum*, n. sp. (Pl. XLII. fig. 5).

The colony forms a fleshy irregular mass, the flat extended base covering the stem of a species of *Macrocystis*, while the upper portion forms a head consisting of numerous rounded tufts carrying the polyps. On close examination these appear as the terminal branches of the short, thick, and sometimes even also branched twigs, which spring from the cœnenchyma.

The polyps are crowded in the terminal tufts, less numerous in the branches and basal portion; they are in circles on the tufts, but are somewhat bilaterally placed on the other parts of the colony. The upper two-thirds of the polyp can be completely retracted; the body and cœnenchyma are well provided with small spiny spindle-shaped spicules. These spicules are also found in the bases of the tentacles, which are folded together when being withdrawn.

The colony measures in its longest diameter 130 mm., it rises to an average height of 55 mm. The flat membranous basal extension is about 100 mm. in diameter. From the cœnenchymal mass short thick branches arise chiefly in an oblique direction; these soon divide into thick ragged lateral twigs of various lengths; finally ending in knobby buds, which are spherical or oval in outline, and thickly covered with the polyps.

The branches vary from 15 to 20 mm. in thickness, but are often little more than globular projections from the basal membrane; the twigs are from 8 to 10 mm. in diameter, and of an average height of 10 mm.

The polyps on the basal portion and the branches are so tightly packed together as to touch one another; they are more or less obliquely placed on the branches. Around the edge of the retracted polyp are eight small projections, which cannot completely close over the polyp opening. The bases of the tentacles are armed with two converging spicules.

The numerous canals in the ramifications of the colony are the direct continuations of the gastral canals of the polyps, and in several instances ova were to be found on the mesenterial filaments; four of the mesenterial filaments were much shorter than the others. The partition walls between the polyps are of a moderate consistency, about 0.5 mm. thick, and contain some small spicules, and an extensive system of inosculating nutrient canals which are interspersed between the polyps. The outer covering is but little thickened, its mesoderm is well furnished with spicules, which in dried specimens give the whole a somewhat rigid consistency.

In the cœnenchyma and the polyp bodies the spicules are numerous, though scattered irregularly.

The spicules are small spindles and rod-like forms; these are sometimes spiny, sometimes with processes at right angles to their main shafts; there also occur small double stars, with the two whorls of spines distinct from each other; there are also to be found some quite irregular spicules.

The spicules measure 0·3–0·02; 0·28–0·03; 0·2–0·025; 0·15–0·025; 0·12–0·04 mm.

The colour of the colony in spirits is a greyish-white.

*Habitat*.—Station 151, off Heard Island; depth, 75 fathoms.

A quite similar form, but probably a young colony, was found by Studer at the Cascade Ridge, N.E. Kerguelen, also on the stem of a *Macrocystis*; its colour in life was noted as "pale red"; the specimen has been lost.

*Alcyonium sollasi*, n. sp. (Pl. XLII. fig. 4).

The colony presents a more or less lobulate form, which is attached to, and embedded in, a mass of hardened sand and mud. One colony measures about 75 mm. in its widest, and 65 mm. in its narrowest diameter, and is about 45 mm. in height. Another measures 90 mm. in length, by about 60 mm. in width, and is about 40 mm. in height. The basal attachment is but little wider than the rest of the colony, and only a very narrow rim is destitute of polyps. The lobes are sometimes simple, at other times they are bifid or trifid; they are short, papilliform, not finger-like; they often grow very tightly against one another, thus altering their original shape.

The polyps are numerous and very closely packed together; they are completely retractile within the body-cavities, and when withdrawn, the basal portion next to the cœnenchyma is drawn together and over the retracted portion, forming eight protuberances, which make an eight-rayed star. In dried specimens these slightly project above the cœnenchymal surface, and are from 1·5 to 2 mm. in diameter.

The spicules of the cœnenchyma are, for the most part, stachelkeulen. These form a continuous layer on the outer surface of the colony, giving it a well-marked consistency. In addition there are spiny spindles, both straight and bent, and also some spiny spindles with broad, spiny heads, resembling, but different from, the stachelkeulen.

The spicules measure:—The stachelkeulen 0·2–0·0; 0·16–0·06; 0·12–0·08 mm. The straight spiny spindles 0·22–0·04; 0·3–0·08; 0·4–0·06 mm. The curved spiny spindles 0·34–0·04; 0·34–0·06 mm. The spiny spindles with spiny heads 0·26–0·06; 0·22–0·04.

Colour in spirits, light brown.

*Habitat*.—Station 313; entrance to the Straits of Magellan; depth, 55 fathoms.

*Alcyonium haddoni*, n. sp. (Pl. XLII. fig. 6).

In this species the colony forms very variously shaped and sized masses, which grow over the dead stems of a species of Muriceid. In one specimen the colony consists of a but slightly elevated mass, about 40 mm. in length, by about 10 mm. in its widest central diameter; it is growing around the axis of a Muriceid. The edge of the colony,

which folds over the stem, is for a breadth of 3 mm. destitute of polyps, and is of a paler colour than the rest of the mass. The polyps are found over the whole of the slightly elevated portion. In another specimen, the colony divides into two portions, one of which rises from the base to a height of 25 mm. and 33 mm., with a very uniform thickness of 15 mm. The other branch only rises to about half this height; the common base measures about 25 by 15 mm. In a third specimen there are several distinct heads.

The polyps are completely retractile, just as in the previously described species. When the polyps are fully expanded, the eight lobes of the base form a portion of the body column, the middle of which contains but few spicules, and these are very small. Some of the expanded polyps, though contracted in the spirits, measure 4.5 mm. in height and 2 mm. in diameter, across the tentacular coronet.

The cœnenchyma is moderately hard, containing stachelkeulen. The basal portion of the tentacles is tightly packed with straight and spiny spindles, these forming a complete coronet, from which some of the spicules proceed up along the dorsal aspect of each tentacle. At the basal portion of the polyps, where the body sinks into the cœnenchyma, the stachelkeulen are met with.

The colour in spirits is an orange-yellow; polyps greyish.

The spicules measure:—The stachelkeulen 0.18–0.04; 0.12–0.06 mm. The curved spiny spindles 0.7–0.04; 0.5–0.04; 0.42–0.04; 0.38–0.04 mm. The straight spiny spindles 0.4–0.04; 0.36–0.06 mm. Some short spindles with blunt protuberances measure 0.22–0.08; 0.18–0.06 mm. A few four-rayed forms occur, varying from 0.36–0.1 to 0.06–0.06 mm.

*Habitat*.—Station 308, Messier Channel; depth, 175 fathoms; bottom, mud.

### Genus *Bellonella*, Gray.

*Bellonella*, Gray, Ann. and Mag. Nat. Hist., ser. 3, vol. x. p. 148, 1862.

*Cereopsis*, Saville Kent, Quart. Journ. Micr. Sci., N.S., vol. x. p. 397, 1870.

*Iphethyrus*, W. Koch, *Neue Anthozoen*, Marburg, 1886.

*Nidalia (pars)*, Gray, Proc. Zool. Soc. Lond., 1835, pt. 3, p. 60.

*Bellonella bocagei* (S. Kent) (Pl. XXXVII. fig. 2; Pl. XLII. fig. 7).

*Cereopsis bocagei*, S. Kent, *loc. cit.*, pl. xxi. figs. 5–13.

*Iphethyrus speciosus*, W. Koch, *loc. cit.*, fig. 3.

*Nidalia atlantica*, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 635, Taf. i. fig. 5, a, b, c.

Specimens of this species were found off the Azores; the specimens vary somewhat in size, and the polyps are in various stages of contraction, in some cases being completely withdrawn, so as not to resemble the description or figures given by Saville Kent. The genus was originally established by Dr. Gray for a species from Australia.

The spicules are chiefly slender spiny spindles, with a few short spiny spindles, and some irregular and four-rayed forms. Some of the spicules are of a delicate pink hue. The slender spiny spicules, straight and curved, measure 0.45–0.04; 0.36–0.04; 0.32–0.02; 0.24–0.02 mm. The short spiny spindles are 0.16–0.06; 0.12–0.06 mm. The four-rayed forms measure 0.1–0.1; 0.1–0.08 mm. The irregular pink spicules measure 0.22–0.08; 0.2–0.06 mm.

*Habitat*.—West of the Azores; depth, 450 fathoms.

### Genus *Anthomastus*, Verrill.

*Anthomastus*, Verrill, Amer. Journ. Sci. and Arts, ser. 3, vol. xvi. p. 376, 1878.

*Sarcophytum*, Koren and Danielssen, Nye Alcyonider, &c., p. 7 (*pars*), 1883.

Verrill established this genus for a deep-sea species, taken off Sable Island, N.S., as follows:—"Alcyonarian forming a large rounded polypiferous mass, raised on a stout, short, barren peduncle. Polyps [autozooids] few, very large, spiculose, entirely retractile, into eight-rayed cells. Rudimentary zooids [siphonozooids] numerous, minute, scattered between the polyps. Cœnenchyma abundant, firm, finely spiculose." Only one species, *Anthomastus grandiflorus*, was described. Later Verrill redescribed this species<sup>1</sup> from a large number of specimens taken off Beaufort, N.C., also in deep water (410 to 458 fathoms). Some of the younger of these had short peduncles, but in others the peduncle was very elongated. In all cases it terminated at the base in several, often numerous, lobulate branches, which were more or less subdivided into lobes, irregular in form and size, but mostly having small constricted bases, so that they were easily broken off. Many specimens were dredged by the "Blake," off Dominique, St. Vincent, Grenada, &c.

Koren and Danielssen (*loc. cit.*) describe as *Sarcophytum purpureum* a species which belongs to this genus and in which the siphonozooids are ovigerous. The following two species, which we cannot refer to either of the known forms, were found by the Challenger.

*Anthomastus canariensis*, n. sp. (Pl. XXXVII. fig. 4; Pl. XLI. fig 7).

The colony consists of from twelve to thirteen autozooids, and very numerous siphonozooids. The base is adherent, being attached to an old worn fragment of a coral stem. The adherent portion of the base is about 20 mm. long by about 10 mm. wide; where it grows over the coral stem it is very thin, allowing the dark colour of the coral to be seen through it; it then rises to a height of 5 mm., forming a somewhat oval column about 12 mm. in its greatest and 7 mm. in its least diameter; but it is not possible to say when the creeping base merges into the column, or it again into the polyp-bearing

<sup>1</sup> Bull. Mus. Comp. Zool., vol. xi. p. 41.

portion; and there does not seem to be any difference in the spicules of any of these regions, as is often so strikingly the case.

The capitulum forms a globular mass, soft but not flabby; the very large autozooids giving it, on a casual glance, an angular appearance. The whole colony, from its base to the top of the capitulum, is 13 mm. high, and the latter projects slightly over the columnar portion.

The autozooids are thirteen in number,—one had been partially torn away. They are of large size, evidently quite retractile within very shallow verrucæ, the eight dentations of which can close over the retracted polyps. These verrucæ, when the polyps are protruded, measure 3, 4, and 5 mm. in diameter. One of the extruded polyps, with partially expanded tentacles, though contracted by the spirits, measures 8 mm. in height; the pinnæ seem wide for the length of the tentacles.

The siphonozooids are very minute, the oral openings, when contracted, not being visible to the unassisted eye, and they do not give the roughened appearance so well seen in the other species of the genus; so far as can be ascertained, without injury to the unique specimen, ova are not present in either the auto- or siphonozooids.

The general colour is a bright red, the tentacles and bodies of the polyps being of a lighter hue.

The straight spiny spindles measure 0·5–0·04; 0·4–0·04; 0·26–0·04 mm.; the four-rayed forms 0·1–0·1; 0·08–0·08 mm. The minute stachelkeulen are very uniformly 0·06–0·04 mm. The flattened spicules with spiny edges, contracted in the middle and more or less expanded at both ends, measure 0·12–0·02; 0·1–0·02 mm. The broad spindles, with blunt projections, measure 0·2–0·06; 0·16–0·06; 0·12–0·06 mm. The irregular after-branching spiny forms measure 0·46–0·04; 0·4–0·04; 0·36–0·06 mm.

This species seems allied to *Anthomastus purpureus* (K. and D.), but is easily recognised by the differences in the siphonozooids, and especially by the differences in the spicules.

*Habitat*.—Station 3, south of the Canaries; depth, 1525 fathoms.

*Anthomastus steenstrupi*, n. sp. (Pl. XLI. fig. 8).

The colony consists of a sterile base and stem, with an expanded capitulum, which latter bears the auto- and siphonozooids.

The basal portion grew embedded in sand, shells, &c. It is furnished with a few nipple-like processes, some of which probably were continued into short stolons. The sterile columnar portion is oval in section, and is slightly ribbed; it is 18 mm. in height and about 10 by 6 mm. in breadth. The polyp-bearing portion projects considerably, forming a convex disc resting on the stem; the projections are not symmetrical, the greatest being at right angles to the broader side of the column; the disc is nearly

circular, measuring 25 mm. across; the upper surface is very slightly convex. It is of a firm, dense consistency.

Seven autozooids arise around the edge of the capitulum; they are retractile within verrucal openings, which measure 4 mm. across; the verrucal edges are scarcely indented. One extruded polyp, with retracted tentacles, measures 8 mm. in height. The pinnæ of the tentacles appear to be short, and much less developed than those of the previous species.

The siphonozooids are conspicuous, about three within the range of 1 mm.; they project sufficiently over the surface of the cœnenchyma to give it quite a roughened appearance; they are of a slightly paler colour than the surrounding surface. They are found equally over the convex lower and convex upper portions of the disc, and are ovigerous.

The colour of the colony is a dull red.

The spicules measure:—The long slender spiny spindles 0·5–0·02; 0·4–0·02 mm. The four-rayed forms 0·24–0·06; 0·34–0·1 mm. The shorter spiny spindles 0·3–0·04; 0·24–0·04 mm. Some long rod-like spicules, with enlarged roughened heads, occur, which measure 0·2–0·04 mm., and the double crosses vary from 0·1–0·06 to 0·06–0·06 and 0·06–0·04 mm.

This species, especially in the auto- and siphonozooids, also resembles *Anthomastus purpureus* (K. and D.), but the difference in the spicules is very great.

*Habitat*.—Station 235, Japan; depth, 565 fathoms.

#### Genus *Sarcophytum*, Lesson, *emend.* Marenzeller.

*Sarcophyton*, Lesson, Belangé's Voyage aux Indes orientales, and Zoologie du Voyage de la Coquille, Zoophytes, p. 92, 1831.

*Sarcophytum*, Marenzeller, Zoologische Jahrbücher, Bd. i. p. 351, 1886.

The colony is mushroom-shaped, polyps dimorphic; autozooids and spot-like siphonozooids, placed on the upper surface of the colony, which forms a convex expansion, and is supported on a stalk-like sterile stem. The disc in process of growth often becomes wrinkled at the edges; the folds for the most part becoming once again plaited or remaining unaltered. The upper surface of the disc is generally soft and elastic; owing to the numerous openings of the siphonozooids it has a shagreen-like appearance. The autozooids are perfectly retractile, and are more numerous towards the margins of the disc; they have not well-developed siphonoglyphes.

The siphonozooids, with four very short and four longer septa, have the siphonoglyphes well developed; they are sexless.

A compact outer layer of small club-shaped spicules is present, except on the basal portion of the stalk. The spicules of the cœnenchyma of the disc are slender rods or spindles, with scattered spines or warts, seldom exceeding 0·02 mm. in breadth. The



cœnenchyma of the stalk contains many spiny warty spindles, large and small, the warts often coarse and distant; also warty cylinders about half as broad as long, with thickly warted double spindles.

*Sarcophytum tongatabuensis*, n. sp. (Pl. XLI. fig. 10).

The colony has been torn from its basal attachment, but is nearly perfect; it consists of a sterile columnar portion, and of a mushroom-like capitulum, bearing dimorphic polyps.

The columnar portion, which has been slightly injured, is hard and compact, 26 mm. high, and of a flattened oval form. In section its basal diameters are 16 and 10 mm., and from this tapering to diameters of 11 to 7 mm. just under the head. There is a slight constriction of the column at a height of 10 mm. from the base; below this the surface is rough with large spiny spindles, while above it is smooth, though somewhat wrinkled.

The capitulum is mushroom-shaped, dense, and of a hard consistency. After it rises from the stalk it folds over, forming a deep gutter-like channel surrounding the latter, which is 4 mm. wide. From the edge of this projecting portion it rises into a convex oval head, the extreme measurements of which are 30 by 20 mm. in width and breadth, and from 7 to 8 mm. in height.

The autozooids are scattered over the whole of the edge and upper surface of the capitulum, being more numerous and closer together on the rim of the edge. They are completely retractile, within pit-like depressions in the cœnenchyma, the walls of which can contract over the polyps when these are withdrawn. On the withdrawal of the body of the polyp, the tentacles seem to be simply folded together against one another, and then also they are drawn in.

The siphonozooids are numerous, scattered all over the surface of the capitulum, which is not occupied by the autozooids, the largest measure quite 0.5 mm. in diameter they are slightly depressed below the surface of the cœnenchyma. The colour of the column is a dull brown; of the capitulum a lighter hue.

The spicules of the sterile stem measure:—The curved spiny spindles 1.3–0.3; 1–0.2 mm. The straight spiny spindles 1.06–0.2; 1.3–0.2; 1–0.2 mm. The irregular branching forms 1.2–0.3; 0.9–0.3 mm. The four-rayed forms 0.8–0.5; 0.76–0.2; 0.6–0.4 mm. In the polyps the spiny spindles measure 0.6–0.1; 0.8–0.06; 0.5–0.06 mm. In the tentacles some slender curved and straight spiny spindles occur 0.16–0.02 mm.; and some with broader heads 0.24–0.04 mm.

*Habitat*.—Station 272, off Nukalofa, Tongatabu; depth, 18 fathoms.

*Sarcophytum atlanticum*, n. sp. (Pl. XLII. fig. 3).

The colony consists of a sterile short stem, and a large deeply folded and spreading capitulum, bearing the dimorphic polyps; the total height of the colony is 70 mm.

The colony has been torn from its attachment, which had apparently been among shell debris, or to rock surrounded with the same; several *Balani* had bored their way into its base.

The sterile column is about 50 mm. high; it is broadly but irregularly oval in section, measuring 40 mm. in its broadest, and 27 mm. in its narrowest, diameter. The lower 20 mm. is distinguished from the upper portion by being rough with spicules, whereas the upper part is smoothish and finely wrinkled and striated. The whole substance is soft and rather spongy in the wet specimen. The capitulum is irregular in form, projecting over the column; in the wet specimen it is softish. While about 65 mm. in its broadest, its average width is not more than 45 mm. It is deeply plicated; the plicæ form four principal folds, of which the two on the one side are twice as large as those on the other. Each fold is also again deeply notched, one fold even twice. All these folds turn down like the lobes of an ear, and lie against the surface of the column. These lobes are at their bases about 8 mm. in thickness, but decrease to a width of 4 mm. at their free edges, which are somewhat inverted.

The autozooids are completely retractile within pit-like cavities, the walls of which, on the retraction of the polyps, almost completely close together, leaving but minute dimples to mark their places. The autozooids were in the unique specimen, well filled with ova of varying sizes up to 1 mm. in diameter. They are scattered over the whole of the upper surface of the capitulum, though most crowded at its edges.

The siphonozooids are numerous, apparently occupying all the spaces not otherwise filled by the autozooids; about three of them occur in the length of a millimetre. The mesoderm is greatly developed and of a firm gelatinous nature.

The colour of the whole mass is that of a dull brown.

The spicules of the sterile stem measure in the trunk:—The curved and straight intercalated spindles 1·0–1·2; 1·1–0·16; 0·96–0·14; 0·9–0·16; 0·56–0·08 mm. The branching spindles measure 1·4–0·2 mm. The spiny clubs measure 0·52–0·08; 0·4–0·06; 0·36–0·06 mm. In the capitulum, the coenenchyma contains some spiny spindles with one end narrow, the other broad, measuring 0·3–0·04; 0·3–0·02; 0·22–0·02 mm. The four-rayed forms measure 0·1–0·1; 0·3–0·06 mm. In the tentacles some curved and straight spiny spindles occur, measuring 0·54–0·04; 0·44–0·02 mm.

*Habitat*.—Station 135, Tristan da Cunha; depth, 60 fathoms.

This seems to be near *Sarcophytum glaucum*, but is the only species of the genus from the Atlantic.

*Sarcophytum philippinensis*, n. sp. (Pl. XXXVIII. fig. 1; Pl. XLI. fig. 9).

The colony consists of a sterile stem and an expanded flattened polyp-bearing capitulum. Polyps dimorphic. The mass is attached to portions of broken shells, sand, &c.

The stem is broadly flattened, 40 mm. at its widest, and about 21 mm. at its narrowest diameter; as the capitulum sits upon it sideways it is higher behind than before; the former measures 45 mm. in height, the latter not more than 15 mm. The texture of the lower 15 mm. of the stem is rough with spicules, while the upper portion is comparatively smooth, and is very finely striated, the striæ being continued up to the very edge of the polyp-bearing portion of the capitulum. The stem is firm, though elastic.

The capitulum is in the form of a pair of unequal sized, irregular shaped, flat lobes, with involuted edges. The lobes are themselves again lobate, these lobes having a tendency to lie over one another. It is about 70 mm. in its widest diameter, the larger lobe is about 60 mm. broad, the smaller is 45 mm.; nowhere are these lobes thicker than 5 mm. The surface on drying is granular.

The autozooids are scattered irregularly over the whole surface of the capitulum, leaving but dot-like openings when completely withdrawn.

The siphonozooids are numerous, and in a dried morsel seem to be more conspicuous than is usual in species of this genus.

The colour of the colony is a dark brown.

This species resembles in form *Sarcophytum glaucum* (Q. and G.), but the spicules are different.

The spicules of the stem measure:—Those of the trunk—the tuberculated spindles 0.8–0.16; 0.8–0.1; 0.6–0.08; 0.54–0.06 mm.; the spiny curved spindles 0.5–0.06; 0.04–0.02 mm. In the capitulum the stachelkeulen measure 0.14–0.06; 0.14–0.04 mm. Some spicules, with large spiny heads, measure 0.34–0.08; 0.26–0.06 mm.

*Habitat*.—Station 208, Reefs off the Philippines; depth, 18 fathoms.

*Sarcophytum ambiguum*, n. sp. (Pl. XLI. fig. 2).

The colony consists of a well-developed column, and a mushroom-like capitulum. The whole structure is soft and most easily torn, and unfortunately the unique specimen is greatly contracted and somewhat tattered.

The column is oval in section, tapering, about 40 mm. in height. It has a basal diameter of 12 mm., and gradually tapers to a diameter of 9 mm. just below the commencement of the expanded head. The average narrow diameter of the column is 7 mm. The first 18 mm. from the base is roughened, the upper portion is smoother and finely striated. It was attached to sand and shell debris, possibly by a few stolon-like prolongations.

The capitulum is broadly oval, projecting upwards, funnel-shaped, resembling a *Clitocybe* rather than an *Agaricus*; it projects over the column in its long diameter, about 25 mm. on either side. It is concave on its upper surface, the long diameter of which measures from 60 to 70 mm., with a width varying from 45 to 50 mm. (The

capitulum is in too ragged a state to admit of any very exact measurements.) Where it arises from the column it has a diameter of 4 mm., but this thins out to one scarcely exceeding 1 mm. at the very edge, which is slightly everted. The outer coating of the capitulum is very thin, with small feebly developed spiny spindles (clubs), and the gelatinous mesoderm of the polyp tubes is thin. The surface is smooth.

The autozooids are scattered all over the upper portion of the capitulum, being very crowded around the edges; they are filled with ova. As usual they are completely retractile, though most of those on the specimen were killed while expanded, which is apparently an unusual phenomenon among species of this genus. There is a collaret of minute rod-like spicules, with a few lateral spines on each, surrounding the bases of the tentacles of the polyps.

The siphonozooids are numerous, scattered all over the capitulum, between the autozooids.

The colour in spirits is a dull brown, but the polyps contain numerous *Zoanthella*, which may have given the capitulum in life a greenish-yellowish hue.

The large tuberculated spicules of the sterile stem, which are often branched and sometimes curved, measure 1.7–0.2; 1.3–0.18; 1.1–0.18; 1–0.12; 0.9–0.06 mm. There are also some nearly smooth spindles, measuring 0.9–0.1; 0.6–0.8 mm.; and a few spiny spindles, with tuberculated heads, measuring 0.26–0.04; 0.24–0.06; 0.2–0.04 mm. In the capitulum the spiny spindles closely resemble stachelkeulen, the spiny broadened heads being well marked,—these measure 0.24–0.02; 0.2–0.02; 0.08–0.02; 0.06–0.02; 0.02–0.01 mm. Some four-rayed forms are interspersed, measuring 0.06–0.06 and 0.04–0.04 mm. In the polyp, curved and straight, smooth, or very fully spined spindles occur, measuring 0.6–0.02; 0.34–0.02; 0.18–0.02; 0.16–0.06 mm. In the tentacles some lenticulate forms occur, which measure 0.06–0.02 and 0.04–0.02 mm.

*Habitat*.—Banda.

There is a specimen in the Paris Museum, somewhat resembling this in external shape, with a label "*Sarcophyton lobulosum*, Less., Seychelles; Rousseau, 1842," but the spicules are quite different.

*Sarcophytum glaucum*, Q. and G. (Pl. XLII. fig. 2).

*Sarcophytum glaucum*, Quoy and Gaimard, Voyage de l'Astrolabe, t. iv. p. 270, Zoophytes, pl. xxii. figs. 11, 12.

The colony is attached to a mass of coral rock. It is of very irregular outline, with a base of nearly 70 mm. in diameter.

The column is almost hidden by the folding downwards of the lobes of the capitulum; it is however distinct, of irregular outline, adhering to the inequalities of a piece of coral

rock. It is from 10 to 20 mm. in height, with a broad diameter of 70 mm. and a medium diameter of 40 mm. in width. It bends upon itself into two nearly equal portions, which have an average diameter of about 20 mm. each. The marginal zone for about 5 mm. in width is rough, as in the other species of the genus, while the upper portion of the column is divided into constrictions partly corresponding to the lobes of the capitulum; it is wrinkled.

The capitulum is very extensively lobed, the lobes often growing over one another. The whole mass, which in shape follows the contour of the column, or nearly so, might be described as kidney-shaped, with an outer convexity of 130 mm., and an inner concavity of about 60 mm. On each half of the head there are about six principal lobes, each of which is again lobed; the outer edges of each lobe are everted and fold down against the column; the inner edges between each pair of lobes fold in over the central portion of the capitulum; these meet those from the opposite lobes, sometimes growing over one another, and quite concealing from view the central portions of the capitulum. Thus the upper surface of the capitulum has the appearance of a Meandrine coral. The texture is rough.

The autozooids are numerous, well marked, and arranged on the lobes with a certain amount of regularity, in rows parallel to the edges of the lobes, with an average distance from each other of 1.5 mm., with about .1 mm. between the rows. The polyps of one row appear to be alternate with those of the adjoining row.

The siphonozooids are numerous, not easily perceived when the specimen is taken fresh from spirits, but quite perceptible on a dried morsel.

The colour is of a uniform dull brown.

The spicules of the sterile trunk measure—the tuberculated spindles 0.54–0.14; 0.42–0.1 mm.; the more slender spiny spindles 0.44–0.06; 0.34–0.04; 0.22–0.02 mm. Those of the capitulum measure—the straight or curved spiny spindles 0.3–0.02; 0.16–0.02 mm.; the club-shaped forms, with roughened heads 0.18–0.04; 0.16–0.04 mm.; and the four-rayed forms 0.3–0.06; 0.26–0.08; 0.16–0.06 mm.

*Habitat*.—Off Kandavu, Fiji Islands.

*Sarcophytum trocheliophorum*, Marenzeller, var. *amboinense* (Pl. XLI. fig. 11).

*Sarcophytum trocheliophorum*, Marenzeller, Zool. Jahrb., Bd. i. p. 359, Taf. ix. figs. 5, 6.

*Sarcophytum pulmo*, Ehrenberg, Klunzinger (*non* Esper).

A specimen in the collection appears to belong to this species, which is very widely distributed throughout the Indian Ocean. It had been attached to a mass of soft coral rock, by an irregular clinging base, from which a short column was developed; this has the rough lower layer and the smoother upper portion, and varies in height. The basal portion adapts itself in great measure to the inequalities of the surface to which it adheres.

The column is in some places about 30 mm. high, but in others not more than 15 mm.; where it joins the capitulum, it becomes divided into a number of buttresses, corresponding in great measure to the lobular divisions of the head. It is of a firm rigid nature.

The capitulum is of a very irregular outline, consisting of at least five lobes, each of which forms a tongue-like mass, folding down over the column, and being applied to it; these lobes, by mutual growth against one another, become more or less elongated, and have their edges very deeply inverted. The broader diameter of the capitulum is about 50 mm., with an average narrow diameter of 35 mm., and a depth of 5 mm. The irregular basal diameter of the column is 100 mm.

The surface of the capitulum when dry is firm, rigid, and somewhat smooth.

The autozooids are numerous; they occur all over the surface of the capitulum, and are arranged with a certain regularity in spiral rows. In a dried morsel the polyp orifices are 0.5 mm. in diameter, with an average distance between each of 1.5 mm., and the same between the rows. The polyps are as usual completely retractile within cavities in the mass.

The siphonozooids are also numerous, and appear to be arranged in circles around the autozooids; about four can usually be counted from one autozooid to another; they seem more conspicuous than usual in this genus.

The mesoderm seems largely strengthened by spicules. The colour is a dark brown.

The spicules of the sterile stem measure—the tuberculated spindles 0.4–0.16; 0.36–0.2; 0.34–0.2; 0.3–0.1; 0.28–0.1 mm. In the capitulum the straight or curved spindles measure 0.32–0.6; 0.3–0.06 mm.; the clubs with bifid or spiny heads 0.2–0.08; 0.14–0.06 mm.; the four-rayed forms 0.14–0.14; 0.12–0.08 mm.

The above details are given, because we have not had the opportunity of a comparison with the type species of either Klunzinger or Marenzeller; the varieties of this species are also very numerous.

*Habitat*.—Reefs, Fiji.

#### Genus *Lobophytum*, Marenzeller.

*Lobophytum*, Marenzeller, Zool. Jahrb., Bd. i. p. 352, 1886.

Colony not mushroom-shaped. Polyps dimorphic both autozooids and dot-like siphonozooids, occurring only on the lobes.

The colony gives rise to lobe-like or finger-shaped processes from its upper surface, which scarcely overhang the sterile basal portion. The upper surface of the polyp-

bearing portion is compact, resistant, and owing to the oral openings of the siphonozooids, it is shagreen-like.

The small club-shaped spicules of the outer layer are not so well-marked as in *Sarcophytum*; they are plentiful only on the stem. The spicules of the cœnenchyma of the polyp-bearing portions of the colony are numerous, being spindles with many and large echinulate warts in zones, averaging 0.05 mm. in breadth. The spicules of the outer layer of the stem are longer spindles, with large distant warts in zones, short double cylinders, or cylinders somewhat longer than broad, and in both these the warts have a tendency to form zones.

*Lobophytum marenzelleri*, n. sp. (Pl. XLII. fig. 1).

The colony consists of a somewhat broadly oval mass, which is attached to several of the prongs of a *Porites*, from which it has been in part torn. It is about 50 mm. in height by about 60 in width.

The sterile column is of an irregular oval shape, at one end somewhat distorted by growing round a projection of the *Porites*. It measures at its base 40 mm. by 25 mm., and what may be regarded as the strictly columnar portion is about 130 mm. high. The outer coating is wrinkled, but not very rough. A narrow, slightly projecting, roughened rim extends round the actual basal attachment. The texture is firm and rigid; the very dense mesoderm of the polyp tubes is crowded with immense spicules, some of which measure 3 mm. long by 0.75 mm. in width.

The capitulum consists of a large number of short lobes, all of which rise quite upright, not at all projecting over the columnar portion. These are mostly again divided into smaller lobes, the whole forming a very convoluted head, which measures 60 mm. by 50 mm. around its most expanded portion. It is of a hard dense consistency, and is as fully packed with very large spicules as the sterile column. The surface, on drying, is rough.

The autozooids are scattered over the whole of the surface of the lobes; they are retractile within pit-like depressions in the cœnenchyma.

The siphonozooids are very minute, and hardly perceptible, even with a lens.

The colour is a light brown.

The spicules of the sterile column measure—the large tuberculated spindles, the tubercles in whorls, and the spindles, often curved, 4.2-4; 4.2-2.1; 2.4-1.7 mm. Those of the capitulum measure—the spiny irregular spindles 0.24-0.06; 0.16-0.04; 0.1-0.04 mm.

*Habitat*.—Api, New Hebrides; depth, 60 to 70 fathoms.

## Family IV. XENIIDÆ.

*Xenidæ*, Verrill, Proc. Essex Inst., vol. iv. p. 148.*Xenina*, Ehrenberg, Die Corallenthiere des rothen Meeres (Reprint, p. 53).*Aleyonina exsertæ*, Klunzinger, Die Korallthiere des rothen Meeres. p. 39.Genus *Xenia*, Savigny.*Xenia elongata*, Dana.*Xenia elongata*, Dana, Zoophytes, p. 606, pl. lvii. fig. 5.

Dana describes this species, of which the habitat was unknown, as of a brownish colour; the only species in the Challenger collection was, when first examined, of a pale blue tint, which has bleached to a nearly perfect white in the spirit. It seems, however, to approach very closely to Dana's species, and as such we venture to record it.

*Habitat*.—Amboina; shallow water.

## Family V. TUBIPORIDÆ.

*Tubiporidæ*, Verrill, Proc. Essex Inst., vol. iv. p. 148.*Tubiporina*, Ehrenberg, Die Corall. des rothen Meeres (Reprint, p. 58).*Tubiporina*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 130.Genus *Tubipora*, Linneus.*Tubipora musica*, Linneus.

Some fragments of this species, which is not uncommon in the shallow waters of the tropical seas, were met with in some coral debris from Samboangan.

This species was also found at Santa Cruz, Major Island, opposite Samboangan; living specimens were dredged from a depth of 10 fathoms; the beach was covered with "cart-loads of the dead and dried coral."<sup>1</sup>

## Family VI. CORNULARIDÆ.

*Cornularidæ*, Dana, Zoophytes, p. 627.

" Kolliker, Icon. Histiol., pt. ii. p. 13.

*Cornularinæ* et *Telestinæ*, Milne-Edwards, Hist. Nat. des Coralliaires, pp. 104. 112.*Cornularidæ*, Verrill, Proc. Essex Inst., vol. iv. p. 148.*Cornularinæ*, Klunzinger, Die Korallthiere des rothen Meeres, p. 42.*Cornularida*, v. Koch, Skolet d. Aleyonarien, Morph. Jahrb., Bd. iv. p. 474.

Within this family, as defined by the authors above quoted, we include those polyp colonies in which the individuals are united either by stolons or by a basal membrane, so as to form incrustations over foreign objects; or in which they develop into bush-like

<sup>1</sup> Narr. Chall. Exp., vol. i. p. 664.



ramifications, by the means of lateral buds arising from the individual members, but in which the colonies are always without an axial skeleton.

The various modifications of growth exhibited by the Cornularidæ show that the group is a very diverse one. But though the forms are numerous enough, they are usually linked closely together, and have been readily derived from one another. The simplest representatives are to be met with in *Cornularia* proper, in *Rhizoxenia*, and in one division of the genus *Clavularia*. In these we distinguish (*a*) individual polyps in which the anterior portion of the body is either not retractile into a posterior part (as in *Rhizoxenia*), or can be drawn into a region definable as the calyx (as in *Cornularia* and *Clavularia*), and (*b*) where the cylindrical tubes or stolons arise from the bases of the polyps and unite the latter. The formation of new polyps by budding takes place on stoloniferous prolongations which are simple projections of the three body-layers of the polyps and include continuations of their alimentary cavities. In one group of *Clavularia*, which we distinguish as "*Membranipoda*," instead of there being cylindrical stolons between the polyps there is a flat basal expansion into which the prolongations of the polyps are continued as endodermic tubes. The basal expansion may present the form of a thin plate on which the polyps are seated, or it may be thickened as a cœnenchymatous mass enclosing a portion of the polyps, with the bases of their alimentary cavities sunk therein. In this case the endodermal tubes arise not only from the base of the alimentary cavities themselves, but also from the lateral walls so far as they are enclosed by the cœnenchyma, which is thus penetrated by a network of nutritive canals. This is the case in *Anthelia*, Sav., *Sympodium*, Ehrbg, *Erythropodium*, Köll., *Callipodium*, Verr., *Sarcodictyon*, Forbes, where, however, the cœnenchyma is still narrow and stolon-like. Another mode of growth is exhibited by *Telesto*, Lam., and *Calogorgia*, M.-Edw. In these a polyp rises to a definite height from its basal surface or from a stolon; this implies a considerable thickening of the polyp walls in order to afford the requisite support. Into this thickened wall fine endodermal canals penetrate from the alimentary cavities of the polyps, and from these buds may develop, rising at various levels on the lateral wall of the original polyp, but without direct connection with its alimentary cavity. These buds may again develop into long polyp-tubes and then give off secondary buds until a ramified arborescent form is the result. This attains its highest development in *Calogorgia*. A remarkable specialisation of this last type leads to the Pennatulid-like structures found in *Pseudogorgia*, Köll.

As regards the skeleton very diverse conditions prevail. *Cornularia* forms only an ecto-skeleton of a horny substance, surrounding the calyx tubes. In others spicules are developed in the mesoderm. These may at times enter into such close mutual connection that rigid calyx tubes are produced. This is well seen in *Cyathopodium*, Verrill, where the condition of the Tubiporidæ is shadowed out.

In general terms we may describe the Cornularidæ as a starting point from whence the higher orders of Alcyonaria have been differentiated.

The following genera have been hitherto distinguished :—

<i>Rhizoxenia</i> , Ehrbg.	<i>Gymnosarca</i> , Sav. Kent.
<i>Cornularia</i> , Lam.	<i>Telesto</i> , Lamx.
<i>Clavularia</i> , Quoy and Gaim.	<i>Pseudogorgia</i> , Köll.
<i>Sarcodictyon</i> , Forbes.	<i>Cælogorgia</i> , M.-Edw.
<i>Cyathopodium</i> , Verrill.	<i>Anthelia</i> , Sav.
<i>Scleranthelia</i> , Studer.	<i>Sympodium</i> , Ehrbg.
<i>Anthopodium</i> , Verrill.	<i>Erythropodium</i> , Köll.
<i>Cornulariella</i> , Verrill.	<i>Callipodium</i> , Verrill.

Many of the species of these genera are shallow-water forms, and the Challenger collection includes only representatives of *Clavularia*, *Telesto*, and *Sympodium*, of which several new species are described. We add to these a description of the hitherto very insufficiently known *Cælogorgia palmosa*, M.-Edw., of which we had fresh specimens from Madagascar.

#### Genus *Clavularia*, Quoy and Gaimard.

- Clavularia*, Quoy et Gaim. *cf.* Blainville, Dict. d. Sci. Nat., vol. lx. p. 499, 1829.  
 .. Milne-Edwards et J. Haime, Distrib. method. Polyp. foss. des terr. paleoz., p. 180.  
 . Milne-Edwards, Hist. Nat. des Coralliaires, p. 106.  
 .. Studer, Alcyon. der "Gazelle," Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, October 1878, p. 632.  
 .... .. Duch. et Mich., Corall. des Antilles, *non* Kölliker, Icon. Histol., *non* v. Koch. Morph. Jahrb., Bd. vii.

This genus was first established by Quoy and Gaimard for a Cornularid from the Pacific, and was briefly defined by Blainville (*loc. cit.*) as including *Cornularia*-like polyps in which the body-wall exhibited externally longitudinal ribs, and was encrusted with long navicular spicules. The polyps were said to be mutually united by stolons.

For the reception of species in which the polyps were seated on a basal membrane, Studer (*loc. cit.*) widened the generic diagnosis, and included within the genus those species in which the colony was crustaceous, the polyps having retractile tentacles, their outer walls being ribbed and furnished with spindle-shaped spiny spicules, the mutual connection being by stolons or by a basal membrane.

The polyp of *Clavularia* consists of a more or less elongated rigid calyx, and of a wide anterior portion which includes the tentacular and œsophageal regions, and which may be completely retracted within the calyx. The margins of the calyx close round the invaginated portion, forming an eight-rayed star. The wall of the calyx exhibits

eight more or less distinct longitudinal furrows, which extend sometimes throughout the entire length, sometimes only along the upper portion. The body-wall projects in ridges between them. The mesoderm of the polyp is beset with spicules which are closely apposed to one another and so make the calyx into a rigid tube.

These spicules are for the most part thick spindles, covered all over with rough warts, and enlarging at one end into a club-like form. Rod-shaped curved spicules also occur, especially in the longitudinal grooves. The retractile portion of the polyps contains either no spicular elements, as in *Clavularia crassa*, or thin spindles and rods which may extend even into the tentacles. They are usually disposed in eight longitudinal strands, which are then continued into the tentacles.

Even the œsophageal tube may contain spicules, as for instance in *Clavularia frigida*, Danielssen. In the colonies united by stolons, the stolons arise from the bottom of the calyces, which become narrowed at their bases and give origin to one or more cylindrical or flat processes from which new polyps are budded off. This formation of stolons agrees exactly with that met with in *Cornularia*. In some species the base of the polyps broadens out into a membrane which unites the individuals together. In this case the base of the calyx gives origin to endodermal tubes, which anastomose on the basal membrane, and thus connect the alimentary cavities of the various polyps. The calyces are always seated upon the stolons or upon the basal membrane, and are never sunk into them as in *Anthelia* or *Sympodium*. The polyps usually arise at relatively great intervals from one another. It may happen, however, that two arise close together; or, as a rare case, one polyp arises at the base of the calyx of another, so as to produce the social condition so well seen in *Telesto*. But even then the alimentary cavity of the bud is not in direct connection with that of the polyp, being only united to it by fine nutritive canals which ramify from the wall of the calyx.

The species as yet known are not numerous; of those provided with stolons *Clavularia viridis*, Quoy and Gaim., from Vanikoro in the Pacific Ocean, was the first described. *Clavularia* (*Cornularia*, Milne-Edw.) *crassa*, M.-Edw., from the Mediterranean, was described in detail by Kowalevsky and Marion.<sup>1</sup> By the same authors a second Mediterranean species was distinguished as *Clavularia petricola*. The species in which the polyps are united by a basal membrane are *Clavularia violacea*, Quoy and Gaim., *Clavularia rosea*, Studer, and the northern forms *Clavularia borealis*, Koren and Danielss., *Clavularia arctica*, Koren and Danielss., and *Clavularia stormi*, Koren and Danielss. As not belonging to the genus *Clavularia* may be mentioned *Clavularia riisei*, Duch. et Mich., and *Clavularia prolifera*, v. Koch. Both these belong to the genus *Telesto*, Lamx.

The species of *Clavularia*, in which the individuals are united by stolons, are in habit very like those of *Cornularia*. On this account Milne-Edwards refers the

<sup>1</sup> Ann. Mus. Hist. Nat. de Marseille, p. 9.

Mediterranean species *Clavularia crassa* to *Cornularia*, although the wall of the calyx is furnished with spicules.

The following three species of this genus occurred in the Challenger collection :—

A. *Stolonifera*.

*Clavularia tubaria*, n. sp. (Pl. XLII. fig. 10).

The flattened stolons are connected in a reticulate manner. The calyces of the polyps are widely separated from one another. They grow to a height of 17 mm., and are ribbed throughout their entire length. They are narrow at the base and gradually broaden out above. The spicules are thick rough spindles, covered with tubercular warts and warty clubs. The colony surrounds the dead stock of *Lophohelia candida*. The stolons are 0·8 to 1·2 mm. in breadth, somewhat flattened and sometimes broader than the base of the polyps which spring from them. They form an irregular wide meshwork, in which the stolons lie at angles of 45° to 90° to one another, leaving triangular or four-cornered interspaces. The polyps originate at the points of intersection or on the ends of simple stoloniferous processes, or more commonly the polyps which spring from the stolons give off on two or three sides new stolons which unite with the processes from other polyps. The calyces are rigid, and rise (with a basal thickness of 1 mm.) to a height of 14·5, 16 to 17 mm. They gradually increase in breadth, and attain at the oral extremity a diameter of 2 mm. Their longitudinal axis is seldom straight, usually slightly bent, and often exhibits a slight sigmoid upturned curvature.

Eight deep radial furrows extend from the oral region to the base of the calyx, where they become obliterated. Between these the calyx wall projects in eight longitudinal ridges, which reach to the calycine margin, and there pass down the opening of the calyx into the indrawn tentacular portion, coming together in such a way that the calyx seems to be closed by an eight-rayed star. The retractile portion of the polyp includes the œsophageal portion, the oral disc, and the bases of the tentacles. In all the polyps it was drawn in into the interior of the calyx, so that the bases of the tentacles were found sunk in the invaginated œsophageal portion, while the tentacles themselves lay folded together over the oral disc. The spicules of the calyx wall are thick warty spindles and clubs, which are closely packed together in the ribbed portion, three or four in a row. Thus the calyx has a rigid character. Among the spicules one can distinguish thick clubs closely beset with spiny warts (0·28 mm. or 0·32 mm. in length and 0·16 mm. or 0·13 mm. in diameter at the thicker end), spindles with rounded ends, straight or slightly curved, and beset with broad spiny warts, in length and breadth 0·33 and 0·067 mm., or 0·4 and 0·041 mm., or 0·18 and 0·07 mm. The largest and thickest spicules lie in the middle

line of the ribbing while towards the grooves they decrease in size. The rough spindles are continued on the retractile portion of the polyp wall, but they are there smaller and less thickly set in the mesoderm. Thick, warty, transversely disposed spindles form a ring under the base of the tentacles, while some spindles are continued on to the tips of the tentacles; these spindles measure 0.1 to 0.18 mm. in length, with a diameter of 0.07 mm. They are closely packed, but are not continued into the pinnæ. In the wall of the œsophageal tube scattered spicules also occur. In the wall of the stolons the spindles become smaller, more delicate, and more sparsely beset with warts; the spicules are often slightly curved, but even here they form a thick layer. They measure 0.4 mm. in length by 0.04 mm. in breadth.

The colour of the colony as preserved in spirit is white.

The species is distinguished from all related forms by the marked development of the calyx.

*Habitat*.—Station 23, lat. 18° 24' N., long. 63° 28' W.; near Sombrero Island, West Indies; depth, 450 fathoms.

#### B. *Membranipoda*.

*Clavularia elongata*, n. sp. (Pl. XLII. fig. 11).

The polyps rise from a thin basal membrane which covers a dead univalve shell. They attain a height of 12 mm., and occur in part singly, in part in groups. The individual polyps are narrowed superiorly, but are swollen out at the base. The wall of the calyx is somewhat flabby.

The membrane which contains the endoderm canals is thin, slightly stretched, and filled with spicules. The polyps spring especially from its margin, but are few in number. Each includes a calyx portion, with completely retractile tentacles and an œsophageal region. The calyx portion is about 12 mm. in height; near the somewhat thinner base it expands to a thickness of 4 mm., while superiorly it measures but 3 mm. The wall is rough owing to spiny spicules which are embedded in it, but it is not rigid, rather in fact flabby and yielding. Distinct broad grooves run from the base to the oral region; between these the wall shows eight broad and slightly projecting ridges; when the polyps are retracted the oral region presents the form of an eight rayed star.

The tentacles, which are provided with spicules, are folded together over the oral disc, and by the infolding of the wall below the oral region they are partly drawn into the calyx.

Spicules are embedded in the calyx ribs in longitudinal bundles; they are bright silvery spindles, slightly curved, and with a tendency to assume a club-shape by being slightly thickened and truncated at one end. They are beset by sharp somewhat distant spines. Their length and breadth vary, and are respectively 0.53 and 0.042,

0.6 and 0.067, 0.35 and 0.058 mm. The tentacular portion is furnished with numerous thin spindle-shaped spicules, which bear widely distant spines, they measure 0.4 and 0.033 mm. in length and breadth. These form a collar around the base of the tentacles, and longitudinal bundles of spindles are found extending into the apices of the tentacles. The young polyps arise near the base of the old ones, which explains the grouped arrangement of the polyps.

The colour of the spirit specimens is a greyish-white.

This species exhibits a close relationship with some of the northern forms, in which the tentacles are usually strongly spicular, and the calyx wall is not very rigid, but beset with large spiny spicules.

It is most closely allied to *Clavularia arctica*, Koren and Dan., from which it is however distinguished by the form of the spicules.

*Habitat*.—Station 78, off the Azores, lat. 37° 26' N., long. 25° 13' W.; depth, 1000 fathoms; bottom, volcanic mud.

*Clavularia cylindrica*, n. sp. (Pl. XLIII. figs. 9, 10).

The basal membrane forms a thick covering over the stem of a species of *Dasygorgia*. The polyps arise from the whole surface vertically and at intervals of 1 to 2.5 mm. On the apex of the colony they are more closely grouped together. In all cases the retractile portion of each is completely withdrawn within the calyx. The calyces are cylindrical, measuring 4 to 6 mm. in height, and on an average 2 mm. in diameter, but slightly broadened at the base. The eight calycine ribs extend along the entire length, and only become obliterated at the basis. The polyp walls are firm and do not collapse when dried. In the ribs the spicules are disposed in thick longitudinal bundles. The tentacles also contain numerous spicules. In the calyx these are in the form of thick spindles, which are thickly covered with spiny warts. Their length and breadth vary, and measure respectively 0.43 and 0.067, 0.3 and 0.04, 0.15 and 0.05, 0.18 and 0.03 mm. The tentacles also contain spicules, which, converging towards the median longitudinal axis of each, extend on to the apex. The tentacular spicules are blunt, spiny, straight spindles, from 0.2 and 0.025 to 0.18 and 0.05 mm. in length and breadth.

The species diverges somewhat from the other forms of *Clavularia* in this, that the basal membrane is relatively thick, and forms a foundation for the lower portion of the alimentary cavity of the polyps. From the embedded portion proceed four endodermic stolons into the coenenchyma. The reproductive organs are found in the projecting cylindrical portion of the polyps.

The colour of the spirit specimen is a yellowish-white.

*Habitat*.—Station 135c, off Nightingale Island, Tristan da Cunha; depth, 100 to 150 fathoms.

Genus *Telesto*, Lamouroux.

- Telesto*, Lamouroux, Nouveau Bull. Soc. Philom. Paris, 1812; Hist. d. Polyp. flexibles, p. 252, 1816.  
 „ Dana, Zoophytes, p. 632, 1846.  
 „ Verrill, Mem. Bost. Soc. Nat. Hist., vol. i. p. 5, 1866.  
*Carijoa*, F. Müller, Arch. f. Naturgesch., Jahrg. xxxiii. Bd. i. p. 330 Anm., pl. ix. fig. 56, 1867.  
*Telesco* and *Alexella*, Gray, Ann. and Mag. Nat. Hist., ser. 4. vol. iii. p. 21, 1869.  
*Clavularia*, v. Koch, Morph. Jahrb., Bd. vii. p. 467, 1881.

The original diagnosis of Lamouroux is—"Polypier phytoide, rameux, fistuleux, cretacéo-membraneux, opaque, strié longitudinalement." He includes within the genus three species—*Telesto lutea*, *Telesto aurantiaca*, *Telesto pelasgica*. Dana added another species, *Telesto fruticulosa*, also from the American coast. As the result of Verrill's investigation of Dana's species, the generic diagnosis was emended as follows:—"Corallum tubular, arborescent, increasing by lateral buds from upright branches and sometimes also by basal stolons; walls thin, firm, membranous or like parchment, with eight longitudinal sulcations. Polyps wholly retractile, separated at the base from the cavity of the branch by a thin membrane." Gray, who changed *Telesto* into *Telesco*, described (*loc. cit.*) a new species, *Telesto smithii*, which diverged in its mode of growth from the typical forms, so that Gray felt himself thereby at once warranted in distinguishing three subgenera—(1) *Telesco*, for *Telesto aurantiaca*, Lamx., and *Telesto ramulosa*, Verrill; (2) *Telescella*, for *Telesto nodosa*, Verrill, which Verrill's own subsequent investigation showed to be an Annelid-tube; (3) *Alexella*, for *Telesto smithii*. Other species which must be referred to this genus have been described under manifold names by various authors. Thus Dana described a species as *Gorgonia trichostemma*; Fritz Müller, another from the Brazilian coast as *Carijoa rupicola*; Duchassaing and Michelotti, another form from the West Indies as *Clavularia riisseyi*. Koch gave an excellent detailed investigation of an East Indian form, which he called *Clavularia prolifera*, v. Koch.

In reviewing the various species belonging to this genus, it is possible to distinguish two main groups. In the first, to which the typical *Telesto aurantiaca* would belong, the structure of the polyps and the sparse ramification of the colony remind one of *Clavularia*. This may be regarded as a subgenus in contrast to those species in which the lateral calyces have a different shape from those of the main polyps, and the entire colony forms a large ramified mass. *Telesto rupicola*, *Telesto smithii*, *Telesto prolifera* may be regarded as types of another subgenus. For this latter F. Müller's designation *Carijoa* may be adopted, since this was first applied to a species of this subgenus. Gray's *Alexella* was of later date.

The characters of the genus may be given as follows:—

From a membranous base, or from stolons which form a delicate network, the individual polyps arise. In structure they are like those of *Clavularia*. From the

polyp walls, which are penetrated by endodermic canals, buds arise. These sometimes develop into simple polyps, but sometimes form long polyp-tubes, which again give off lateral buds. The walls of the polyp calyces, into which the anterior tentacle-bearing oral portion may be completely retracted, contain spicules. In some species these form a continuous network, in others, they are more loosely disposed, and in part are united together by a horny substance. In both cases, the mesodermal layer of the calyx wall acquires a tubular and rigid character. In all cases there can be distinguished (1) principal polyps which form the stem and branches of the colony; these may be termed *axial polyps* of the first and second rank, and (2) *lateral polyps* which are disposed upon the former, usually in spirals. The axial polyps form long tubes with stiffened walls, which are thickened from the apex towards the base. The upper hollow portion, which includes the oral cavity along with the crown of tentacles and the œsophageal tube, is soft, and either beset with loosely disposed spicules, or is altogether without them; it can be retracted into the calyx tube in the same way as in *Clavularia*. The alimentary cavity of the polyp extends the entire length of the calyx tube; the mesenteric folds are limited to narrow ridges. According to Koch, in *Telesto prolifera* only two dorsal folds are continued down to the bases, while the other six cease much sooner. In another species, *Telesto arborea*, n. sp., the mesenteric folds form narrow creases which may be followed to the base. Spicules occur throughout the entire calyx wall, and in *Carijoa* are united together by a horny substance.

The calyx wall furthermore contains a canal-system, consisting of fine endodermic canals, which are in communication with the alimentary cavities of the axial polyps. From these there arise the buds of new polyps, which sometimes remain short, and sometimes develop into long axial polyps of the second order. The latter again produce buds, from which axial polyps of the third order may arise. In some species the axial polyps appear to produce no generative elements, which then seem to be restricted to the secondary individuals. This is the case in *Telesto arborea*, n. sp., where an alternation of generations might therefore be said to occur.

Subgenus *Telesto*, s. str. (= *Telesco*, Gray).

The axial polyps spring from stolons or basal prolongations which spread over foreign bodies; they are not very long, and they give origin, on their side walls, to polyps going off at right angles, and differing but little in form or in size from the axial polyps. These polyps may, in their turn, bear accessory polyps. The whole colony is low and only slightly ramified. The calyx wall is for the most part marked by eight longitudinal ribs, with corresponding furrows. The spicules form broad, dentate discs, or ramified, irregular bodies, whose spines interlock so that a continuous layer is formed in the mesoderm.



Here may be placed—

<i>Telesto aurantiaca</i> , Lamx.		<i>Telesto ramulosa</i> , Verrill.
<i>Telesto fruticulosa</i> , Dana.		

*Telesto rigida*, n. sp. (Pl. XXXVII. fig. 3; Pl. XLII. fig. 9).

The long solitary polyp tubes arise from stolons, which creep over dead coral, &c. The main polyps have lateral polyps which arise more or less at a right angle, and these again may give rise to a third series. The polyp walls are rigid and smooth; the spicules, interlocking with one another, form a continuous layer, thus constituting a fairly solid tube. The colour is an orange red.

The stolons are flat, and overrun dead coral and other foreign bodies. They sometimes end in terminal polyps. The primary polyps attain a height of 10 to 16 mm. with a diameter of from 2 to 3 mm. These are narrow at their bases, widening gradually towards the oral regions. The terminal portion of the polyp is soft and retractile: when retracted, the terminal portion assumes the appearance of an eight-rayed star. The outer polyp wall is smooth.

Individual polyps sometimes lengthen out into axial polyps of 25 mm. in height, and these bear lateral polyps, which arise at irregular intervals. Some of these latter develop buds; but further ramifications do not seem to be developed. The lateral polyps do not differ in form from the main polyps, and are about 10 mm. high and 3 mm. in diameter.

The spicules which are found in the polyp walls are mostly of irregular forms, but are more or less flattened, and elongated in one direction. On either side of these flattened discs more or less deep and even branching dentations are found; on the surface of some blunt projections are seen, and interspaces, which would seem to indicate that they are the result of smaller spicules fused together. These spicules become often so much interlocked that they cannot be separated even after maceration and boiling with caustic potash. Their size and form vary greatly, length and breadth of some being respectively as follows, 0·37 and 0·12; 0·183 and 0·058; 0·083 and 0·043; 0·183 and 0·05; 0·1 and 0·05 mm.

In the retractile portion of the polyps the spicules become more spindle-like and form loose bundles. The tentacles are full of longitudinal bundles of spindle-shaped spicules beset with sharp spines. These have a length and breadth respectively of 0·3 to 0·032; 0·25 to 0·025; 0·283 to 0·028 mm.

The species is distinguished from those allied to it by the form of the spicules and the absence of the usual longitudinal ridges and furrows.

*Habitat*.—Station 71, west of the Azores; depth, 1675 fathoms; bottom, Globigerina ooze.

Subgenus *Carijoa*, F. Müller, 1867 (*Alexella*, Gray, 1869).

The axial polyps are very large, and differ greatly from the minute lateral polyps. The walls of the axial polyps are thick, and contain a horny substance, which surrounds the spicules and binds them together. The spicules are rod-like, with few spines. The colonies form usually tall, *Gorgonia*-like, ramified masses.

Species :—

<i>Telesto (Carijoa) smithii</i> , Gray.	<i>Telesto (Carijoa) rupicola</i> , F. Müll.
„ „ <i>riisei</i> , Duch. et Mich.	„ „ <i>arborea</i> , n. sp.
„ „ <i>prolifera</i> , v. Koch.	„ „ <i>trichostemma</i> (Dana).

*Telesto (Carijoa) rupicola*, F. Müller.

*Carijoa rupicola*, F. Müller, Arch. f. Naturgesch., Jahrg. xxxiii. Bd. i. p. 330 Anm., pl. ix. figs. 56, 57, 1867.

A colony found at Bahia, at a depth of 10 to 20 fathoms, agrees in every particular with the excellent description and figure given by F. Müller, so that there can be no doubt as to the identity of the two forms.

When the colony grows over a level surface, the flattened stolons form a delicate network, from the connecting portions of which the long axial polyps arise. In some places the stolons anastomose laterally, and thus form more or less broad plates, which again divide at their edges into isolated stolons. The axial polyps may be 120 mm. high.

The spicules, which in form and size correspond with the description given by Fritz Müller, lie close together, but with no definite regularity, in the wall of the calyx; they are bound together, though this seems to have escaped Müller's notice, by a mesh of horny substance.

The colour in spirit is whitish. According to Müller it is yellow or reddish during life. The retractile portion of the polyps, and the crown of tentacles, are snow-white.

*Habitat*.—Bahia; depth, 10 to 20 fathoms.

Fritz Müller found the species also on the coast of Brazil.

*Telesto (Carijoa) arborea*, n. sp. (Pl. XXXIX. figs. 1, 1a).

This species forms ramified masses which rise from a level base to a height of 200 mm. The axial polyps bear others of the second order which attain considerable length, sometimes even 150 mm., but these seldom bear axial polyps of the third order. The lateral

polyps are cylindrical, relatively large, and stand upright, or at an obtuse angle upon the axial polyps.

The stolons, which are closely packed together, and sometimes united to form plates, spread themselves over foreign bodies, such as masses of sand, Gorgonid axes, &c. From them there arise axial polyps of the first order, and smaller single polyps, of which some may bear buds.

The main polyps rise, in a somewhat twisted and bent manner, to a height of 160 mm. From their base to the summit, where the retractile portion of the polyp is met with, they decrease slightly in thickness. At the base the diameter is about 3 mm., near the summit 1.5 mm. The main polyps bear, in part, tube-like lateral polyps disposed in ascending spirals, in part, long axial polyps of the second order, the latter forming long branches which sometimes overtop the main polyps. These, like the main polyps, bear lateral polyps, but seldom short axial polyps of the third order.

The lateral polyps are cylindrical, have cylindrical calyces, are 5 mm. in length and 1 to 1.2 mm. in diameter. The outer walls of all the polyps exhibit eight longitudinal ridges and furrows, those of the axial polyps running their course quite independently of those of the lateral polyps. The axial polyps form long tubes, the inner cylinder of which remains the same from the calyx to the base of the polyp, while the polyp wall becomes gradually thicker downwards. This inner cylinder is the extended digestive cavity of the axial polyps; on its walls the eight mesenteric folds are continued down to the base of the polyps. These folds form, however, in the deeper portion, but slightly projecting elevations.

In the wall of the polyp tube one can distinguish the ectoderm as a thin covering, the thick mesoderm, and the endoderm lining the cavity. From the mesoderm a thin structureless layer surrounds the endoderm, and is only thickened at the insertion of each mesenteric fold; then a dense layer of spicules, disposed in several strata, occurs. The dentations of these spicules are so much interlocked that they can with difficulty be separated, while the spicules are further fastened together by a horny envelope, which is not so sharply defined towards the exterior. The outermost stratum of the mesoderm exhibits loosely packed spicules, with a soft gelatinous connecting substance. On this a network of fine endodermal canals is spread, which sometimes unite to form larger longitudinal canals; from these fine endodermal canals pass through the horny layer into the digestive cavity of the polyp.

From this canalicular network the lateral polyps and the axial polyps of the second order arise, and their digestive cavities have therefore no direct communication with those of the axial polyps. In the lateral polyps the body-wall is thin, and contains no horny substance. The retractile portion of the polyp contains spicules in longitudinal bundles, which are to be found even in the tentacles. The spicules are fine, bent rods, with scattered, irregularly distributed, prominent sharp spines. Their length and

breadth measure respectively 0·3 and 0·025 ; 0·35 and 0·016 mm. In the inner stratum of the mesoderm the spicules are spindles with sharp spines, which often present ramified projections at both sides. Sometimes these are straight, sometimes bent, and occasionally two or three are closely united.

In length and breadth these measure respectively 0·27 and 0·05 ; 0·23 and 0·03 ; 0·25 and 0·04 mm.

In the tentacles spicules occur of the first form, and also simple, smooth, straight or bent needles.

The colour of the colony in spirit is grayish-white.

*Habitat*.—Station 190, in the Arafura Sea ; lat. 8° 56' S., long. 136° 5' E. ; depth, 49 fathoms ; bottom, green mud.

*Telesto* (*Carijoa*) *trichostemma* (Dana).

*Gorgonia trichostemma*, Dana, Zooph., p. 665, pl. lix. figs. 3, 3a, 3b, 1846.

*Telesto trichostemma*, Verrill, Amer. Journ. Sci. and Arts, vol. xlv. p. 415, 1868.

Dana described, under the title *Gorgonia trichostemma*, an Aleyonarian from the Fiji Islands, which in its habit presents a great resemblance to a species of *Telesto*. Verrill has examined the original specimen and has described it as a parasitic polyp allied to *Cornularia*, and probably a *Telesto*. In part it covered the dead axis of an *Antipathes*, in part it exhibited free hollow branches.

A *Telesto*-like *Cornularid*, which was obtained by the Challenger Expedition in Torres Strait from a slight depth, agrees so well with the representation given by Dana, that we cannot but refer it to the same species. The colony consists of creeping stems, which are beset with lateral polyps, and of single upright branches. The stems arise from stolons which cover foreign bodies and form a thick network, sometimes fusing into flattened discs.

The stems are axial polyps of the first order ; they are at first provided with a thick wall, which gradually becomes thinner in the ascending portion, and this is terminated by the calyx aperture. The creeping portion of the stem attains a diameter of 5 mm., and in old specimens is covered by a parasitic siliceous sponge. In this region the spicules, which lie in the sheath surrounding the gastral cavities of the polyps, form by close apposition a firm tube. In the older portion this is further strengthened by the cementing of the spicules by a horny substance. This horny material gives the tube a yellowish-brown colour, and causes it to exhibit exactly the appearance and consistence of a Gorgonid axis, on which the soft cœnenchyma appears to be cortical. In the younger portion of the stem, the horny substance disappears, and the axial portion has a white colour and a loose consistence.

Only in the ascending terminal portion of the stem do the spicules cease to be united, so that this region exhibits exactly the appearance of an ordinary *Telesto*. From one

side of the stem polyp, single axial polyps of the second order arise, in a straight direction, for 24 to 45 mm. Here again, in the deeper portions, which have a diameter of 4 mm., the spicules form a tube-like axis, which soon becomes loose above, and finally terminates in a sheath of loosely united spicules. Inside the axial tubes, mesenteric folds are still everywhere to be seen. The lateral polyps, which spring from the canal-containing sheath surrounding the axial tube, exhibit a retractile portion and a tubular calyx. The latter has thick walls, is smooth, arises straight from the stem polyp, and is appressed to the ascending axial polyps on the stem portion. The mouth is directed upwards. The diameter is about 1 mm.

The polyps arise in spirals, the fresh buds appearing slightly below the oral region of the calyx on the axial polyps.

Internally the axial polyps exhibit exactly the structure of the other *Telesto* species. Round the endoderm of the gastral cavity, there lies a structureless zone of mesoderm. This exhibits a thickening at the origin of each mesenteric fold, and upon this is a layer filled with spicules, which in the older portions are cemented by a horny substance into a compact tube. Outside this, there is the canalicular layer, from the endodermic tubes of which the lateral polyps or the axial polyps of the second order arise.

The spicules in the axial polyps are elongated spindles with strong lateral spines, often provided with lateral branched processes, or forked at one extremity. In the axial portion the teeth and processes of the spicules interlock with one another so as to establish a firm union. The dimensions of these spicules in length and breadth are respectively as follows—0·13 to 0·04, 0·2 to 0·025, 0·12 to 0·03 mm.; the forked ends diverge for 0·07 mm.; 0·26 to 0·003 mm.

The colour of the colony as preserved in spirit is grey to yellowish. The whole stem, with the exception of the terminal branches, is overgrown by a parasitic sponge.

*Habitat*.—Torres Strait; depth, 3 to 11 fathoms.

Fiji Islands, Dana.

### Genus *Cælogorgia*, Milne-Edwards.

*Cælogorgia*, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 191.

Although no representative of this remarkable genus occurred in the Challenger collection, we may briefly allude to the form and to its relations with the Cornularidæ. Hitherto but little has been known of the type beyond the brief description given by Milne-Edwards. Even its systematic position has been somewhat dubious. The material on which our notice is based was supplied through the kindness of Dr. C. Keller, who collected *Cælogorgia palmosa*, Val., on the coast of Madagascar. The specimens were well preserved in spirit, and were compared with the dried specimen preserved in the collection of the Jardin des Plantes in Paris. The latter was collected by M. Rousseau

in 1841 near Zanzibar, and is the type specimen on which Milne-Edwards' description was based.

The generic diagnosis given by Milne-Edwards is very descriptive and terse:—"Polypiéroide arborescent, dont l'axe est occupé par une cavité cylindrique commune, au lieu d'une tige sclérobasique, comme si le tissu épithélial avait avorté."

The natural relationship was, however, less happily indicated, inasmuch as the genus was ranked along with *Briareum*, *Solanderia*, and *Paragorgia* under the Briaraceæ. Verrill was the first to point out its relationship with *Telesto*.<sup>1</sup> Hitherto only one species—*Cælogorgia palmosa* (Val.) (*Lobularia palmosa*, Val.)—has been discovered, and its distribution appears to be limited to the Mozambique Channel between Mozambique and Zanzibar.

*Cælogorgia palmosa* (Val.) (Pl. XLIII. figs. 1-8).

*Lobularia palmosa*, Val., MSS. Coll. du Mus. Jardin des Plantes, Paris.

*Cælogorgia palmosa* (Val.), Milne-Edwards, Hist. Nat. des Coralliaires, tom. i. p. 191; Hickson, Phil. Trans. for 1883, p. 695.

The colony consist of a stem which rises from a broadened base, attached by stolon-like processes. The stem gives off, mainly on two sides, usually in alternate succession, at obtuse or right angles, large branches or twigs. These may again bear twigs, or may be beset with the club-shaped polyps which arise in spirals at wide intervals. The polyps are not retractile; their tentacles, furnished with spicules, lie down side by side over the oral disc. The apex of the stem, like that of each branch, bears a terminal polyp, the digestive cavity of which is continued as a tube of uniform width throughout the entire stem. The wall of the main axis contains spicules, it tapers from the base to the apex, and is penetrated by canals, which communicate by fine processes with one another. From these canals the branch canals arise. These exhibit the same characters as those of the main axis, and their cavities are never in direct connection with the inner cylinder of the latter. From the canalicular network of the branches the polyps arise, which in structure resemble the terminal polyp, but have but short digestive cavities. New branches and polyps arise in similar manner as buds from the œsophageal portion of the terminal polyps. In the formation of a branch the polyp bud grows in length and then develops lateral polyps on its walls. The polyp bud, however, remains short without forming lateral polyps. We may therefore, as in *Telesto*, regard the stems as consisting of axial polyps of the first order, the branches of polyps of the second or the third. The axial polyps appear, as far as the examination of the one colony is concerned, to be sterile, while the secondary polyps produce generative elements. There is therefore a sort of alternation of generations. The whole colony is rigid and brittle, only in the twigs does it exhibit a slight elasticity.

<sup>1</sup> *Mem. Boston Soc.*, vol. i. p. 5, 1866.

The large specimen in the Jardin des Plantes exhibits a simple straight upright main stem, which is much broadened below. It measures 150 mm. in height, and in diameter 5 mm. On the four sides it gives off, at tolerably wide intervals, thin cylindrical axial polyps of the second order. These either bear small lateral twigs, especially about the middle, or are directly beset with polyps. The latter arise at obtuse or at right angles.

The largest of the specimens, collected by Dr. C. Keller near Nossi Be, is represented in Pl. XLIII. fig. 1, from a drawing kindly placed at our disposal by Dr. Keller. It exhibits a somewhat divergent habit.

The axial polyp of the first order attains a height of 170 mm., and measures 6 mm. in diameter near the base; at a height of 22 mm. it gives off a strong branch, which arises at an angle of 45°, and is beset with polyp-bearing axial polyps of the second order. From that point the stem-polyp is continued upwards in a somewhat spiral course, and gives off its polyp-bearing twigs high above the origin of the first branch. The twigs are strongest and longest about the middle; above and below they are less strongly developed, while just under the apex isolated polyps occur. Other specimens, measuring 130 mm. in height and 4 mm. in thickness above the base, exhibit only one stem with branches disposed on either side. At the middle height these measure about 47 mm. in length and 15 mm. in thickness, and are directly beset with polyps.

In all the specimens the branches show a tendency to broaden out especially in one plane, but an accurate examination of their origin shows that they arise, like the polyps, in spirals round the stem.

According to Dr. Keller the colonies attain a height of 200 mm.

Axial stem-polyp of the first order. The axial stem-polyp exhibits at its upper end the crown of tentacles. This surrounds the oral disc, and in all the specimens the tentacles lie folded together over the invaginated oral disc. Each tentacle is looped or curved, with its apex inwards. The mouth is a longitudinal cleft, surrounded by broad ectodermic projections; it measures 0·21 mm. in length.

The tentacles seem to be short and broad, and have eight short side pinnæ.

The mouth leads into the œsophageal cavity, which seems on cross section to be oval, and attains a length of 1·7 mm. No siphonoglyphe was found,<sup>1</sup> but the tube is covered with a layer of elongated cylindrical cells. After a course of 1 mm. the tube suddenly contracts into a narrow cylindrical sack with thick walls, which leave only a narrow opening. The latter opens into the gastral cavity. This is lined in its œsophageal region by an endoderm of elongated cylindrical cells, which become less conspicuous inferiorly, and more and more flattened. The mesenteric folds exhibit a very slightly developed musculature, indeed muscular fibres are scarcely distinguishable. Under the œsophageal tube they soon decrease in breadth and rapidly disappear below; only the

<sup>1</sup> A siphonoglyphe was found by Hickson, *loc. cit.*, p. 695, pl. 50, fig. 3.

two dorsal folds remain longer demonstrable. The mesoderm wall of the polyps becomes thicker from the apex towards the base, while the diameter of the gastral cavity remains always the same. In the œsophageal region one can distinguish in the upper part, outside the endoderm, a thin structureless layer which is continued into the mesenteric folds. Outside of this lies the gelatinous layer which contains the spicules. In decalcified preparations the sheaths of the spicules may be recognised, sometimes with a trace of the nucleus of the spicule-producing cell. Below the tentacles narrow endodermic canals may be seen to penetrate; they ramify in the mesoderm, and are connected by fine processes with the gastral cavity of the polyp. In the œsophageal portion these nutrient canals dilate to form lacunæ, which in part fuse together (fig. 6) and finally unite further down into longitudinal canals continued on (fig. 7) towards the base. By the increasing thickness of the mesoderm these canals are pressed more and more towards the periphery, while round the central canal the spicules become aggregated to form a sort of axis, which is not, however, definitely limited externally. Between the aggregated spicules a few lacunæ and fine nutrient canals may still be seen. Towards the base the longitudinal canals attain a width which in part exceeds that of the gastral cavity, and at the same time the spicule-containing mesoderm acquires a more considerable thickness. The central canal can then be distinguished with difficulty, and only by its position from the other canals. A cross section of the main axis presents a sieve-like appearance, and reminds one in some degree of the cross section of *Paragorgia*. The canals are continued into the basal expansion, and there exhibit an irregular network.

The axial polyps of the second and third order exhibit a structure quite analogous with that of the above. At their base, however, they are not proportionately thickened, but remain approximately cylindrical. They spring from the lacunæ in the wall of the axial polyps of the first order.

The lateral polyps are club-shaped, 3 mm. in length, at their origin 1 mm. in thickness, but increasing at their ends to 1.2 to 1.5 mm. (fig. 3). They arise at obtuse or at right angles from the axial polyps. Occurring at intervals of 1 to 1.5 mm. from one another, they form spirals in which the fifth polyp comes to lie over the first. Their structure (fig. 5) is essentially the same as that of the axial polyps. The tentacles again appear as simply folded together over the invaginated oral region. The œsophageal tube narrows suddenly below, but the narrow tube into which it is continued is continued laterally on the base of the wider portion, and that on the side turned towards the stem, so that the polyp acquires a bilateral appearance. The gastral cavity is short, and is connected by means of canals, which spring from the base, with the canalicular system of the axial polyps. In the wall of the polyp also nutrient canals are distributed, and the polyp may by longitudinal growth and production of buds develop into an axial polyp.



The buds of axial and accessory polyps always arise near the tentacular portion of the axial polyps, not from the œsophageal portion (fig. 4). At a distance slightly less than 1 mm. below the origin of the tentacles, the first buds appear as warty protuberances, including protrusions of the three body-layers, which enclose a minute lacunar space formed from the expansion of an endodermic canal. Close under these, buds occur in which the still closed œsophageal tube is invaginated from the apex of the wart into the endodermic lacuna to form the future gastral cavity of the polyps. On the margin of the invagination the tentacles are being differentiated. The buds below those above described already appear more cylindrical in form, and exhibit in their essential features the different parts of the adult polyps.

Of interest in relation to the development of the whole is a very young colony only 27 mm. in height. Here one can distinguish (fig. 2) an ascending stem beset with spirally disposed polyps. The stem is a simple tubular polyp, which exhibits a row of tentacles at its extremity. The lateral polyps are likewise cylindrical, and some already exhibit small buds below their tentacles. The whole has exactly the structure of the upper end of an adult axial polyp. The lateral polyps are seen in the act of transformation into axial polyps of the second order.

The spicules are distributed through the entire mesoderm of the colony, and are continued from the stem and branches into the polyps, where they are developed on to the very tips of the tentacles.

They consist typically of straight or curved spindles, which are beset with irregularly scattered spinose warts. In the deeper mesodermic layers of the axial polyps these warts frequently develop into jagged processes, and the spicule thickens at one end into an approximately club-like form. The dimensions of the spicules in length and breadth are 0·37 to 0·033; 0·225 to 0·025; 0·3 to 0·032; 0·16 to 0·016; 0·12 to 0·012 mm.

They are generally disposed in longitudinal strands, and form several strata one above the other. In the axial polyps they form a compact layer round about the gastral cavities, and thus represent a sort of axis.

The colour of the colony when dried or preserved in spirit is white. In the living state they possess, according to Dr. C. Keller, a light chocolate colour with a tint of red. The colour is very quickly lost in spirit.

From the above it is evident that *Calogorgia* has much in common with the subgenus *Carijoa*, to which the genus is doubtless allied. The principal differences are, the more emphasised differentiation between the axial and lateral polyps, the absence of horny substance in the mesoderm, and the non-retractile character of the polyps.

*Habitat*.—Zanzibar (Rousseau).

Nossi Bé in the Mozambique Channel; depth, 10 to 12 metres (Dr. C. Keller).

Genus *Sympodium*, Ehrenb.*Sympodium*, Ehrenberg, Die Corallenth. des rothen Meeres, p. 61.

,, Dana, Zooph., p. 608.

,, Milne-Edwards, Hist. Nat. des Coralliaires, t. i. p. 110.

,, K  lliker, Icon. histiol., pt. 2, p. 141.

,, Klunzinger, Die Korallth. des rothen Meeres, p. 42.

,, Danielssen, Norske Nordhavs-Exped., Alcyonida, p. 141.

*Sympodiad  * (pars), *Massarella*, *Sympodium* (pars), Gray, Ann. and Mag. Nat. Hist., ser. 4, vol. iii. pp. 119–20, 1869.

Ehrenberg (*loc. cit.*) characterises the genus very concisely as follows:—“Basi membranacea, effusa, polypis (in papillas inermes parum prominulas) retractilibus, stipite carentibus.” (*Antheli   retractiles.*)

Klunzinger (*loc. cit.*) emends this diagnosis, pointing out that the polyps are sometimes wholly, sometimes only half retractile, and also that the bottom of the digestive cavity is sunk into the basal membrane, a fact which distinguishes *Sympodium* from those species with membranous bases which belong to *Clavularia*.

On a survey of the already known species, the following diagnosis may be given of the genus. From a membranous basis, which grows over foreign bodies, and is penetrated by nutritive canals, polyps arise, whose bodies are more or less deeply sunk into the membranous c  nenchyma, but so that they project to a greater or less degree above the basal membrane. The polyps are either at definite distances from each other, or they are associated together in groups round which the c  nenchyma thickens considerably so as to raise them above the basal membrane. There are thus formed Alcyonium-like colonies in which the polyps are arranged above each other at various levels. In the part of the polyp which is protruded above the basal membrane, one can always distinguish a calyx-portion, and a more or less retractile anterior region, containing the mouth and the crown of tentacles. The calycine portion is more or less rigid, and is often marked by eight longitudinal ridges, between which are eight longitudinal furrows. The calyx can be closed over the retracted anterior portion of the polyp and then contracts into an eight-rayed star.

The tentacles are frequently armed with spicules, and the   sophageal tube may also contain eight longitudinal bundles of spicules. The form of the spicules varies greatly. Some are smooth, lenticular, others are disc-like bodies; others are spiny and warty spindles.

Gray includes among his *Sympodiad  *, under the generic title *Euno  lla*, *Alcyonium gorgonoides*, Ellis and Solander. This species Milne-Edwards refers hypothetically to *Sympodium*, Ehrbg. The figures given by Ellis and Solander (pl. ix. figs. 1, 2, not 12 as Gray records), are evidently those of a *Palythoa*, with distinct twelve-rayed polyps. This form must therefore be expelled from the series of Alcyonaria.

It is possible to distinguish two main groups:—

(a) Those in which the polyps are distributed over the basal membrane at nearly equal distances. The retractile portion can be more or less withdrawn into the calycine portion, the spicules are smooth, lenticular, circular, or spindle-shaped bodies.

Tropical Species.—This group is closely allied to *Anthelia*, and includes *Sympodium cæruleum*, Ehrbg., *Sympodium fulvum*, Forsk., *Sympodium fuliginosum*, Ehrbg., and *Sympodium purpurascens*, Ehrbg.

(b). Those in which the polyps have a tendency to form elevated Alcyonium-like groups. The calyces are comparatively large, and are beset with prickly or spinose spindles and clubs. The tentacles also contain spicules. These lead on to the forms belonging to the Alcyonidæ.

Northern and deep-sea forms, including *Sympodium abyssorum*, Danielssen, *Sympodium norvegicum*, Kor. and Dan., *Sympodium coralloides*, Pall., and the following new species.

*Sympodium verrilli*, n. sp. (Pl. XLII. fig. 12).

The membranous basis of the colony grows over a fragment of dead coral, and from it rise polyps, standing close together. Their calyx portions protrude but little beyond the surface of the membrane, and the anterior portion can be entirely retracted into the calyx. The calyces are never associated in groups. The margin of the colony is smooth, and bears no polyps. The polyps stand at distances of 1 to 2 mm. from each other. The calyces have a diameter of 2 to 4 mm., and a height of 1 to 1·2 mm., their walls exhibit eight distinct longitudinal ridges separated by deep furrows. When the retractile portion is withdrawn, the calyx is reduced to a low wart forming an eight-rayed star. The retractile portion of the polyp includes the crown of tentacles, which, when at rest, is folded together over the oral-disc, and the œsophagus. It is 5 mm. long, and its walls have elevated ridges. The wall of the basal membrane, like that of the calyx, contains numerous spicules.

The spicules are straight spindles, which bear two or three circlets of spine-like, rectangular projections, and are surrounded at the ends with spines and dentations. Sometimes one end is broadened out and more thickly beset with spines so as to produce a club-shaped spicule; sometimes the longitudinal axis is shortened, and a wheel-shaped spicule is the result. In length and breadth they vary respectively as follows:—0·16 and 0·05; 0·1 and 0·04; 0·13 and 0·04; 0·13 and 0·05 mm.

The retractile portion of the polyp is also richly provided with spicules. These are

spindles, about 0.33 mm. in length and 0.03 mm. in diameter, and are thickly covered with short, sharp spines. The walls of the polyp also exhibit eight longitudinal bundles of thickly disposed spicules. At the base of the tentacles the spicules are arranged in a circle and form a sort of collar. Thence they are continued into the tentacles, in which they lie obliquely and close together. They become gradually shorter towards the tips of the tentacles.

The gastral cavity of the polyp is sunk deep into the relatively thick cœnenchyma.

The colour in spirit of the basal membrane and calyx is milk-white, and that of the retractile portion yellow.

*Habitat*.—Station 320, lat. 37° 14' S., long. 53° 52' W.; bottom, green sand; depth, 600 fathoms.

*Sympodium armatum*, n. sp. (Pl. XLIII. figs. 11, 12).

From a thin membrane which covers a Gorgonoid (*Dasygorgia*), the polyps arise in groups, at wide intervals. One can distinguish a more or less expanded calyx portion with a broad base, and a tentacular portion which is not completely retractile. The calyx wall bears but indistinct longitudinal striæ. In each group five to seven individuals are usually distinguishable, arising close to one another but separated from the next group by a wide interval, over which the naked basal membrane extends. Both the membrane and the calyx walls appear somewhat rough owing to the spinose spicules which are embedded in them.

The calyces are not rigid, they measure 4 to 4.5 mm. in breadth at their base, they narrow rapidly towards the oral region, and are from 3 to 4 mm. high. The anterior portion of the polyp is only partially retractile, so that the tentacles which are folded together over the oral disc cannot be drawn into the calyx, and being provided with spicules form a quasi-operculum. The base of the gastral cavity is sunk into the cœnenchyma of the basal membrane. In the groups each gastral cavity is separate down to the base.

Both the basal membrane and the calyces are beset with large rough spicules, which lie in the calyces in eight longitudinal bundles, but in the membrane they are irregularly disposed. They consist of straight or curved spindles, beset with sharp spines. By the thickening of one extremity they frequently become club-shaped. Their length and breadth vary respectively as follows:—0.7 to 0.04, 0.5 to 0.04, 0.41 to 0.042, 0.38 to 0.04, 0.5 to 0.04, 0.41 to 0.042, 0.38 to 0.03, 0.3 to 0.03 mm. Even the retractile œsophageal portion is covered with fine spindle-shaped spicules.

Under the tentacles, curved spicules, measuring 0.58 to 0.05 mm., form a broad annular collar, which in retracted polyps forms the margin of the calyx.

At the base of tentacles, large spicules occur which converge outwards. They have a broad expanded base and a pointed end, and are beset with sharp spines. They measure up to 0.72 mm. in length by 0.058 mm. in thickness, and form, occurring as they do in several rows one behind the other, a quasi-operculum 2 mm. in height.

The colour of the colony as preserved in spirit is yellowish-white.

*Habitat*.—Station 56, lat. 32° 8' 45" N., long. 64° 59' 35" W ; depth, 1075 fathoms.

*Sympodium glomeratum*, n. sp. (Pl. XLIII. figs. 13, 14).

A thin basal membrane extends over Gorgonoid axes. From this the polyp calyces arise; these are rarely separate, being usually in close groups. This is especially the case where the membrane grows out beyond the substratum, and thickens considerably to form thick cushions, which project to a height of 12 mm. and have a breadth of 6 to 7 mm. From these the polyp calyces arise to varying heights. The colonies then exhibit very much the appearance of a young Alcyonium stock.

The polyps have their lower portion sunk into the cœnenchyma, and present projecting calyces, about 1 mm. each in height and 1.5 mm. in diameter. Into the latter the anterior portion of the polyp may be completely retracted, while the calyx wall closing over forms an incomplete operculum. Eight strong ridges extend up along the calyx wall. When the polyp is retracted, the calyx portion has the appearance of a small wart, upon the top of which the bases of the folded and spicular tentacles may be seen protruding.

The mesoderm of the calyces and of the cœnenchyma is thickly beset with rough spicules. One can distinguish broad curved spindles, beset with spinose warts projecting straight outwards. These spicules have the following length and breadth respectively—0.2 to 0.05, 0.25 to 0.025, 0.16 to 0.067 mm. Besides these club-shaped forms occur others, broadened out at one end, and beset with jagged and spinose processes, as well as with spiny warts. The length and breadth of these vary respectively as follows:—0.2 to 0.05, 0.2 to 0.052, 0.083 to 0.04 mm. Furthermore, there are curved flat bodies, which may be described as crescent-shaped clubs, which are flattened out, and beset with spines and thorny processes. Their dimensions in length and breadth are 0.25 to 0.058, or 0.16 to 0.06 mm. Twin and four-rayed forms likewise occur.

Under the tentacles, the spindles are disposed in a ring so as to form a broad collaret. Short spiny spindles, converging towards the centre, are disposed in several rows at the bases of the tentacles, and these form a sort of operculum. These spindles are covered with straight warts, and are themselves sometimes straight, sometimes curved. In the collaret they measure 0.43 mm. in length to 0.033 mm. in breadth. In the tentacles their length and breadth vary as follows:—0.2 to 0.05, and 0.25 to 0.025 mm.

The colour of the spirit specimen is brownish.

This species is very nearly related to *Sympodium abyssorum*, Danielssen. The tendency of both species to form independent cœenchyma stocks, brings them near to the Alcyonidæ to which they lead up. A similar structure occurs exceptionally in *Sympodium coralloides*, Pall.

*Habitat*.—Nightingale Island ; depth, 100 to 150 fathoms.

## APPENDIX.

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### *Dasygorgia melanotrichos*, n. sp. (*vide* p. 15).

Since the original description of this species was printed off, several additional and almost perfect specimens were found in a jar with a species of *Antipathes*. They were dredged at the same station as the type (Station 343). The more perfect of these prove this species to be the largest of the described forms.

The slender and beautifully iridescent stem arises to a height of over 700 mm. At this height, in one specimen, it gives origin to two branches, which proceed at right angles to the main axis. This latter arises from an irregular spreading calcareous base, which measures 40 mm. by 25 mm. It spreads over several volcanic pebbles. The diameter of the basal portion of the axis is 4 mm., and this gradually tapers to one of 2 mm. just before the origin of the branches. There are some slight evidences of a few small branches on the lower portion of the stem; those on the summit appear at first to form a regular dichotomy, otherwise the description of one such on page 15 is sufficiently exact. The spicular covering on the stem is very easily rubbed off.

### *Melitodes fragilis*, n. sp. (*vide* p. 180).

Since the description of this species was printed, a nearly complete specimen was found in a case containing species of *Alcyonaria* from the Bay of Amboina.

The species proves to be of larger dimensions than, from the fragments first discovered, had been surmised.

The colony, of which a portion only has been preserved, arises from a much branched base probably attached to dead corals; from it numerous branches proceed in an irregularly dichotomous manner, forming a series of somewhat parallel fan-shaped structures, which anastomose with one another and which arise at an acute angle from the basal part.

The internodes are short and stumpy at the base, gradually becoming longer towards the free extremities.

The nodes are large and very conspicuous. The branches extend to a distance of 60 mm.

The colour of the colony is a decidedly pinkish hue ; the basal internodes are deeply and sinuously grooved.

*Siphonogorgia köllikeri*, n. sp. (*vide* p. 236).

Since the description of this species was printed, a complete colony was found in a collection from the Bay of Amboina.

It is attached to a dead Coral, and calls to mind by its general habit the precious Coral ; it is well branched.

The stem gives rise to five diverging branches, of which four arise in the one plane ; these again give origin, but sparingly, to side twigs. The colony is 45 mm. in height and about 60 mm. in width. The branches averaging 27 mm. in length. The diameter of the main branches is 5 mm., that of the smaller ones from 3 to 4 mm.



## GEOGRAPHICAL DISTRIBUTION.

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### ALCYONARIA (exclusive of the Pennatulacea).

The collection of the Alcyonaria, made during the cruise of the Challenger, has added in some measure to our knowledge of the geographical distribution of the group.

Of the distribution in space of the various species, the little that was already known has been chiefly through the labours of Verrill, Pourtalès, and Studer, for in the important volumes of Esper and Milne-Edwards the localities for the species are often unrecorded, or when given are vague and uncertain. The recent works of Koren and Danielssen have added very considerably to our knowledge of the habitats of the northern forms; nor must the memoir of Duchassaing and Michelotti, on the species found at the Antilles, be overlooked, though uncertainty must be felt, owing to the absence of some of the types, about the identity of all the species mentioned by these latter writers.

On a review of the collection made by the Challenger, it seems evident that very many forms remain yet to be discovered in all the oceans, and this not only among shallow-water and reef frequenting species, but also among the species frequenting moderate depths in the sea. Until the record is much more complete, it does not seem advisable to attempt the mapping out of the oceans into "areas of distribution."

We venture, however, on the attempt to give a brief history of what is known as to the distribution of the species of all the well-established genera, so far as these could be ascertained, even when the species have not been taken during the Challenger's voyage.

#### Order I. GORGONACEA.

##### Section I. HOLAXONIA.

##### Family I. DASYGORGIDÆ.

##### *Strophogorgia*, Perceval Wright.

Of the four species of this genus, two, *Strophogorgia petersi*<sup>1</sup> and *Strophogorgia verrilli*, are found in the Pacific Ocean (Japan), while the other two, *Strophogorgia challenger*i and *Strophogorgia fragilis*, are inhabitants of the Atlantic Ocean. In both oceans the species occur between the 32nd and 39th north latitudes.

<sup>1</sup> All the species quoted without an authority are new species described in this Report.

*Herophila*, Steenstrup.

*Iridigorgia*, Verrill.

*Chrysogorgia*, Duch. and Mich., *emend.* Verrill.

All the known species of these genera are from the West Indies. *Herophila regia*, St. = *Riisea paniculata*, D. and M., is in the Copenhagen and Dublin Museums from Jamaica. *Iridigorgia pourtalesi*, V., is from Dominica and Guadeloupe. *Chrysogorgia desbonni*, D. and M., has been found at the Antilles and Caribbean Sea, and off Cuba. *Chrysogorgia fewkesii*, V., was found off St Vincent.

*Dasygorgia*, Verrill.

The species of this genus would appear to be limited to the Atlantic and Pacific Oceans.

In the Atlantic Ocean, *Dasygorgia agassizi*, V., was found during the cruise of the "Blake" as high north as lat.  $41^{\circ} 24' 45''$  N., *Dasygorgia elegans*, V., and *Dasygorgia squamata*, V., occurs off the Barbados, *Dasygorgia splendens*, V., off Santa Cruz, *Dasygorgia spiculosa*, V., from lat.  $25^{\circ} 33'$  N., as far south as St. Vincent, and by the Challenger it has been found at lat.  $9^{\circ} 10'$  S. The largest species of the genus, *Dasygorgia melanotrichos*,<sup>1</sup> was dredged in mid ocean off Ascension Island.

In the Pacific Ocean eight species have been found, of which one, *Dasygorgia flexilis*, occupies an isolated position, being found off the coast of Chiloe; the others are found scattered over the western shores of the Pacific in an area extending from lat.  $35^{\circ} 11'$  N. to lat.  $29^{\circ} 55'$  S. The distribution extending 20 degrees more south on the western shores of the Pacific Ocean than on the eastern shores of the Atlantic Ocean. These Pacific Ocean species may be thus grouped. Japan—*Dasygorgia geniculata*, *Dasygorgia japonica*; Philippines—*Dasygorgia squarrosa*, *Dasygorgia geniculata*, and *Dasygorgia axillaris*; Papua—*Dasygorgia cupressa*; Kermadecs—*Dasygorgia expansa*, *Dasygorgia acanthella*, and *Dasygorgia axillaris*.

## Family II. ISIDÆ.

*Ceratoisis*, Perceval Wright.

In the Atlantic Ocean the distribution is confined to its northern area; *Ceratoisis grayi*, Perc. Wright, was found off the Cape Verde Islands; another species, *Ceratoisis palmæ*, occurs off the Canary Islands; Verrill describes as new *Ceratoisis ornata* from off Nova Scotia, *Ceratoisis (Lepidisis) caryophyllia*, from Guadeloupe, *Ceratoisis (Lepidisis) longiflora*, and *Ceratoisis (Lepidisis) vitrea* from the West Indies; Studer describes *Ceratoisis siemensii* from off Newfoundland.

<sup>1</sup> Vide Appendix, p. 275.

In the Pacific Ocean five species are found, extending from Japan, *Ceratoisis japonica*, Std. and *Ceratoisis paucispinosa*; the Philippines, *Ceratoisis philippinensis*; and the Kermadec Islands, *Ceratoisis grandiflora*, Std. and *Ceratoisis nuda*.

*Callisis*, Verrill.

It may be doubted if this genus differs from *Ceratoisis*; the only species, *Callisis flexibilis*, V. (*Isis flexibilis*, Pourt.), is from the West Indies.

*Isidella*, Gray.

Taking *Isidella neapolitana* (Koch) as the type, it is apparently only found in the Mediterranean.

*Acanella*, Gray.

The principal area of the species of this genus would seem to be the Northern Atlantic, where *Acanella arbuscula*, Y. Johns., is found off the Canaries and Madeira; *Acanella eburnea* (Pourt.), Sombrero Island; and *Acanella simplex*, V., off the Bermudas; besides other species described by Verrill, from the voyage of the "Blake;" of which *Acanella normani*, V., occurs from Martha's Vineyard to the south coast of Iceland and Greenland. Three species have been found in the Pacific Ocean, though at very wide intervals from each other—*Acanella chiliensis* in the Messier Channel, *Acanella rigida* off Banda, and *Acanella gregorii*, Gray, off Japan.

*Sclerisis*, Studer.

The only species of this genus, *Sclerisis pulchella*, Studer, was found at a depth of 597 fathoms, in lat. 35° 21' S., long. 175° 40'.

*Bathygorgia*, Perceval Wright.

The only species of this genus, *Bathygorgia profunda*, Perc. Wright, was dredged off the coast of Yokohama, in lat. 35° 41' N., long. 157° 42' E.

*Primnoisis*, Wright and Studer.

The species of this genus appear to be essentially Antarctic. *Primnoisis antarctica*, Std., *Primnoisis sparsa*, *Primnoisis ambigua*, were found in comparatively shallow water at Prince Edward Island and Kerguelen, but *Primnoisis rigida* was dredged from deep water in the Atlantic Ocean, at Rio de la Plata, and *Primnoisis (Isidella) capensis*, Std., off the Cape of Good Hope.

*Mopsea*, Lamarck.

All uncertainty as to the distribution of the two species of this genus have been set at rest by the discovery of *Mopsea dichotoma* (Lin.) at Port Jackson and of *Mopsea encrinula* (Lamk.) off East Moncœur Island, Bass Strait, and North-West Australia.

*Acanthoisis*, Wright and Studer.

The only species of this genus (*Acanthoisis flabellum*) was found off Port Jackson.

*Isis*, Linneus.

While *Isis hippuris*, L., occurs in the Pacific Ocean, Amboina being one of its habitats, it is curious that no trace of the species occurs in the collection, though large collections were made at Amboina; as to the species described by Steenstrup, the habitats given—"Indian Ocean;" "Seas of America," &c.—leave the exact localities still uncertain. There are specimens in the Bern Museum from Manila, and Ellis and Solander record it from the southern coast of Sumatra.

## Family III. PRIMNOIDÆ.

*Callozostron*, Perceval Wright.

The only species of this genus (*Callozostron mirabilis*, Perc. Wright) was dredged at lat. 65° 37' S., long. 79° 49' E., in the Antarctic Sea, the most southerly dredging made during the cruise of the Challenger.

*Calyptrophora*, Gray.

Both species of this genus come from the Pacific Ocean; *Calyptrophora japonica*, Gray, occurs at Japan, and off the Fiji Islands; there is also a specimen in Paris, labelled as from the Indian Ocean (Bourbon); *Calyptrophora wyvillei* was found north-east of the Kermadecs.

*Calypterinus*, Wright and Studer.

The single species of this genus (*Calypterinus allmani*) was found off the Reefs, Fiji.

*Stachyodes*, Wright and Studer.

The only species, *Stachyodes regularis*, was found off the Kermadecs.

*Stenella*, Gray.

The species of this genus appear to be widely scattered. *Stenella imbricata* (Y. Johns.), the first species described, was taken off Madeira; *Stenella johnsoni* was dredged off Ascension; *Stenella acanthina* occurs off the Rio de la Plata; *Stenella spinosa* was found off Prince Edward Island; *Stenella gigantea* was found at Kandavu, in the Pacific Ocean, while *Stenella doederleini* was dredged off Yokohama, Japan.

*Thouarella*, Gray.

The distribution of the species of this genus in the Atlantic Ocean is limited to the Falkland Islands, where the type specimen of *Thouarella antarctica* (Val.) was found by du Petit Thouars and Capt. J. Clark; to the coast of Patagonia, where *Thouarella köllikeri* was dredged; and to Tristan da Cunha, where *Thouarella affinis* was found. *Thouarella antarctica* (Val.), *Thouarella variabilis* and vars., *Thouarella affinis*, var., have been taken at Prince Edward Island and Heard Island in the Antarctic Ocean. In the Pacific Ocean two species occur, *Thouarella moseleyi* off the Kermadecs, and *Thouarella hilgendorfi* (Std.), which has been met with both south of Papua and at Japan.

*Amphilaphis*, Wright and Studer.

The only species of this genus (*Amphilaphis regularis*) was taken at Tristan da Cunha.

*Plumarella*, Gray.

Of the three species described, one, *Plumarella pourtalesi*, Ver., has been found off the coast of Florida, a second, *Plumarella delicatissima*, off Port Grappler, Patagonia, and the third, *Plumarella penna* (Lamk.), is referred by Milne-Edwards to Australia.

*Caligorgia*, Gray.

The distribution of the species of this genus is rather peculiar; in the Atlantic Ocean *Caligorgia verticillata* (Pall.) is found off the north-west coast of Africa, and extending into the Mediterranean, while *Caligorgia gracilis* (M.-Edw.) is found in the West Indies. In the Indian Ocean, on the authority of a specimen in the Bern Museum, *Caligorgia flabellum* (Ehrb.) occurs at the Mauritius. In the Pacific Ocean *Caligorgia ventilabrum*, Std., is found off the north of New Zealand, *Caligorgia sertosa* south of Papua, *Caligorgia flabellum* (Ehrb.) occurs at Japan and at Formosa, while *Caligorgia compressa* (Ver.) occurs at the Aleutian Islands.

*Primnoella*, Gray.

The species of this genus are found extending along the shores of America, from Sombrero Island on the north-east of South America (*Primnoella distans*, Std.), and Pernambuco, Monte Video (*Primnoella magellanica*, Std., and *Primnoella murrayi*), southwards to Tom Bay, Patagonia (*Primnoella flagellum*, Std.), and up the west coast of South America as far as the coast of Chili (*Primnoella biserialis*). Two species extend to Australia, *Primnoella grandisquamis* and *Primnoella australasiæ*, Gray, being found at Port Jackson and at Twofold Bay.

*Primnoa*, Lamouroux.

The type species, *Primnoa reseda*, L., seems limited to the Atlantic Ocean, where it is found from the Cape de Verdes to the Polar Sea; it has been dredged in deep water off Setubal, at St. George's Bank, and in the Bay of Fundy.

*Primnoides*, Wright and Studer.

The only known species of this genus (*Primnoides sertularioides*) was found off Prince Edward Island in the Southern Ocean.

## Family IV. MURICEIDÆ.

*Acanthogorgia*, Gray.

With one exception the species of this genus are found in the Atlantic Ocean.

The following species are found north of the equator—*Acanthogorgia hirsuta*, Gray, Madeira; *Acanthogorgia armata*, Verr., off Nova Scotia; *Acanthogorgia aspera*, Pourt., Havanna; *Acanthogorgia schrammi* (D. and M.), Guadeloupe; and *Acanthogorgia muricata*, Verr., Barbados. While the following species found during the Challenger Expedition occur south of the equator—*Acanthogorgia riddlei* and *Acanthogorgia laxa*, Patagonia; *Acanthogorgia ramosissima* trends further to the east, being found off Prince Edward Island, in the Southern Ocean. The only species from the Pacific Ocean, *Acanthogorgia longiflora*, was taken off the Philippines.

*Paramuricea*, Kölliker.

The species of this genus are principally to be found in the Atlantic Ocean, but extend as far in an eastern direction as the western shores of Australia. *Paramuricea*

*elegans*, Grieg, is described from Hviddingso, where it was found by Professor G. O. Sars; *Paramuricea grayi* (Y. Johns.), at Madeira; *Paramuricea johnsoni*, Std., and *Paramuricea atlantica* (Y. Johns.), are found off the Cape de Verdes; *Paramuricea borealis*, Verr., and *Paramuricea grandis*, Verr., are from Nova Scotia; *Paramuricea placomus* (Ehrb.) has been found in the Northern Atlantic and the Mediterranean; *Paramuricea æquatorialis* was taken by the Challenger at St. Paul's Rocks, in the Mid Atlantic; *Paramuricea tenuis*, Verr., occurs at the Barbados; *Paramuricea hirta*, Pourt., at Cuba; *Paramuricea laxa* and *Paramuricea ramosa* were found, the former at Sarmiento Channel, the latter at Tom Bay, Patagonia.

*Anthomuricea*, Wright and Studer.

One species, *Anthomuricea argentea*, of this genus, which is nearly related to the preceding, comes from Patagonia; another, *Anthomuricea chamæleon* (Koch), is found in the Mediterranean.

*Muriceides*, Wright and Studer.

*Muriceides fragilis*, the sole representative of the genus, was found off the Philippine Islands.

*Clematissa*, Wright and Studer.

The species of this genus, which is closely related to *Paramuricea*, are all indigenous to the Atlantic; *Clematissa verrilli* was found at Tristan da Cunha, and both *Clematissa robusta* and *Clematissa obtusa* off the coasts of Patagonia.

*Villogorgia*, Duchassaing and Michelotti.

The species of this genus are very widely distributed, *Villogorgia nigrescens*, D. and M., being found in the Atlantic, at Guadeloupe, *Villogorgia mauritiensis*, Rid., in the Indian Ocean; while in the Pacific Ocean *Villogorgia intricata*, Gray, occurs in Bass Straits, Fiji, and the Hebrides, and *Villogorgia gracilis*, Std., at Bougainville, one of the Solomon Islands.

*Echinomuricea*, Verrill.

The known species of this genus appear to be limited to the Pacific Ocean, *Echinomuricea coccinea*, Verr., having been found in the Chinese Sea, and *Echinomuricea indomalaccensis*, Rid., originally described from Torres Strait, has been found at Hong Kong, and by the Challenger off Panay, Philippines.

*Placogorgia*, Wright and Studer.

The only species of this genus (*Placogorgia atlantica*) occupies a quite isolated position off St. Paul's Rocks, in the Atlantic.

*Acamptogorgia*, Wright and Studer.

Both the species found by the Challenger, *Acamptogorgia arbuscula* (Gray) and *Acamptogorgia alternans*, are from the Pacific Ocean, Japan and Fiji; if the species described by Koch<sup>1</sup> as *Muricea bebycoides*, n. sp., belongs to this genus, then its geographical area must be extended to the Mediterranean.

*Echinogorgia*, Köl liker.

All the species of this genus belong to the Indo-Pacific Ocean, *Echinogorgia sassapo* (Esp.) at the Mauritius, *Echinogorgia furfuracea* (Esp.), *Echinogorgia cerea* (Esp.), *Echinogorgia cancellata* (Verr.), and *Echinogorgia intermedia*, Std., off North-west Australia, *Echinogorgia pseudosassapo*, Köl., at Torres Strait, *Echinogorgia ramulosa* (Gray), at the Philippines, while *Echinogorgia flabellum* (Esp.) and *Echinogorgia umbratica* (Esp.) have as localities the "East Indies." *Echinogorgia aurantiaca* (M.-Edw.) has been found off Callao.

*Thesea*, Duchassaing and Michelotti.

*Thesea guadalupensis*, D. and M., is recorded from Guadeloupe; *Thesea gemmata*, Verrill, was obtained from deep water at St. Croix, in the West Indies.

*Acis*, Duchassaing and Michelotti.

Of the three species of this remarkable genus, one, *Acis guadalupensis*, D. and M., was found off Guadeloupe, a second, *Acis orientalis*, Rid., at the Mauritius, while the third, *Acis pustulata*, was found by the Challenger at Japan.

*Muricella*, Verrill.

The central area for the species of this genus would seem to be the East Indies; *Muricella humosa* (Esp.), *Muricella tuberculata* (Esp.), have not been rediscovered, and

<sup>1</sup> Fauna und Flora des Golfes von Neapel, xv. p. 52.



Esper was not acquainted with their habitats, though he thought it probable they were from the "East Indies;" *Muricella complanata*, *Muricella nitida*, Verr., *Muricella perramosa*, Rid., have been found at Japan, the last named also occurring at the Mauritius. *Muricella flexuosa*, Rid., occurs at Hong Kong, *Muricella crassa*, *Muricella umbraticoides* (Std.), and *Muricella tenera* (Rid.), were dredged off Australia and south of Papua, while *Muricella gracilis* occurs at the Admiralty Islands.

*Elasmogorgia*, Wright and Studer.

The only species known of this genus (*Elasmogorgia filiformis*) was found in the Arafura Sea, south of Papua.

*Muricea*, Verrill.

The species of this genus, taking it in its restricted sense, seem to be widely distributed in the tropical seas, being found at China and the East Indies; they apparently abound on the Atlantic and Pacific shores of America, from whence very numerous species have been described by Verrill; one species, *Muricea bicolor*, was met with by the Challenger in the Atlantic, at Bahia.

*Hypnogorgia*, Duchassaing and Michelotti.

*Hypnogorgia pendula*, D. and M., is recorded from Guadeloupe.

*Anthogorgia*, Verrill.

*Anthogorgia divaricata*, Verr., is described as collected by Stimpson at Hong Kong.

*Menella*, Gray.

*Menella indica*, Gray, is recorded from "Bombay, Back Bay (Captain Thompson)." If, as hinted in the Introduction (*ante*, p. liv), a species collected by Dr. Döderlein at Japan belongs to this genus, then the distribution would be thus far extended.

*Menacella*, Gray.

The habitat for *Menacella reticularis*, Gray, is not recorded.

*Heterogorgia*, Verrill.

The two described species, *Heterogorgia verrucosa*, V., and *Heterogorgia tortuosa*, V., come from the Bay of Panama.

*Astrogorgia*, Verrill.

*Astrogorgia sinensis*, Verrill, was found at Hong Kong.

*Bebryce*, Phillipi.

*Bebryce mollis*, Phillipi, has been found at Naples, Messina, and Syracuse. Carus (Prod. Faunæ Medit., p. 60) adds "Distrib. Mareoticum;" can this be so?

*Eumuricea*, Verrill.

The following species, *Eumuricea acervata*, V., *Eumuricea hispida*, V., *Eumuricea tubigera*, V., and *Eumuricea squarrosa*, V., have been found at Panama, while *Eumuricea horrida* (Möbius) was found off the coast of Peru.

## Family V. PLEXAURIDÆ.

The species belonging to the various genera of the family are, without exception, to be found in shallow water, and on this account are but feebly represented in the Challenger collection. The material for determining their geographical distribution is to the present very imperfectly known; it may suffice to mention that the species have been found in both the Atlantic and Pacific Oceans. Species of *Eunicella* seem to be found in the Mediterranean, and to extend along the western shores of Africa as far as the Cape of Good Hope; Verrill records one species, *Eunicella tenuis*, as from the West Indies, but there would seem to be some doubt as to the locality. *Plexauroides prælonga*, (Rid.), occurs at Torres Strait. The West Indies and Japan appear to be the habitats of very many of the known species.

## Family VI. GORGONIDÆ.

*Platycaulos*, n. gen.

The single species of this genus (*Platycaulos danielsseni*) was obtained at Banda.

*Callistephanus*, n. gen.

The only known species of this genus (*Callistephanus koreni*) was dredged off the Island of Ascension.

*Stenogorgia*, Verrill.

Of the two species, one, *Stenogorgia casta*, Verr., was taken in the Atlantic, off the coast of Florida; the other, *Stenogorgia rosea*, Grieg, at Haakonsund, Korsfjord.

*Lophogorgia*, Milne-Edwards.

All the known species come from the south and east coasts of Africa, extending from the Cape of Good Hope district northwards to Delagoa Bay, and as far south as Prince Edward Island.

*Leptogorgia*, Milne-Edwards, *emend.* Verrill.

The very numerous species of this genus, as understood by us, have a somewhat peculiar distribution, commencing with a series of forms like *Leptogorgia viminalis* (Pall.) and *Leptogorgia sarmentosa* (Esp.), which are found in the Mediterranean, the latter extending its area to the Azores; the former and *Leptogorgia webbiana* (Val.), are found at the Canary Islands; *Leptogorgia pinnata* (Lin.), is found at the Gaboon. On the western side of the Atlantic, *Leptogorgia teres*, Verr., has been taken in the Bay of New York, *Leptogorgia floridana*, Verr., at Florida, *Leptogorgia miniata*, Verr., at the Antilles, *Leptogorgia purpurea* (Pall.) at Brazil, Rio Janeiro, and extending around the coast of South America as far into the Pacific Ocean as Chili; *Leptogorgia arbuscula* (Phill.) is found both in Patagonia and Chili, while numerous species, *Leptogorgia flexilis*, Verr., *Leptogorgia rigida*, Verr., *Leptogorgia diffusa*, Verr., &c., are found at Panama; *Leptogorgia cuspidata*, Verr., *Leptogorgia peruana*, Verr., *Leptogorgia ramulus*, (Val.), *Leptogorgia adamsii*, Verr., are recorded from Peru; *Leptogorgia californica*, Verr., *Leptogorgia stenobrachis* (Val.), are from California. A few species are found in Australasia, *Leptogorgia arenata* (Val.) at New Zealand, and *Leptogorgia torresia* and *L. australiensis*, Rid., at Australia.

The general line of the distribution would appear to be along the shores of Africa as far as the Equator; along both the coast lines of America from the 30th degree of latitude, with an outlier in the Pacific Ocean.

*Gorgonia*, Auct. *emend.* Verrill.

All the species of this genus, as now limited, are found in the Atlantic, some in the

Mediterranean, from whence they extend to the Bermudas, then into the West Indies, and down the eastern coast of South America to Brazil.

*Swiftia*, Duchassaing and Michelotti.

The single species described, *Swiftia exserta*, D. and M., was found at Saint Croix, in the West Indies.

*Danielssenia*, Grieg.

The species described by Grieg, *Danielssenia irramosa*, was found at Risør on the coast of Norway.

*Eugorgia*, Verrill.

The species of this genus seem confined to the western shores of America, Peru, Panama, California.

*Xiphigorgia*, Milne-Edwards; *Hymenogorgia*, Valenciennes; *Phycogorgia*, Valenciennes.

The various species of these genera are limited to the Atlantic Ocean, chiefly the West Indies, and the region a few degrees north and south of the Equator. No species of these genera were found during the voyage.

FAMILY VII. GORGONELLIDÆ.

*Nicella*, Gray.

In 1859 Dr. Gray described a species from the Mauritius under the name of *Scirpearia dichotoma*, Gray, and then for the same species, in the Catalogue of Stony Corals in the British Museum, 1870, he established the genus *Nicella*, altering the specific name into *Nicella mauritiana*, as indicative of its habitat.

*Scirpearia*, Cuvier (?).

The species of this genus apparently come from the Atlantic Ocean.

*Scirpearella*, n. gen.

All the species come from the Pacific Ocean, *Scirpearella rubra* being found at Japan; *Scirpearella profunda* and *Scirpearella gracilis* were dredged off the New Hebrides, and *Scirpearella moniliforme* at Amboina.

*Ellisella*, Gray.

The species of this genus, as now limited, would seem to be confined to the Australian Seas.

*Gorgonella*, Valenciennes.

The following are found off the coasts of Australia—*Gorgonella distans*, Studer, *Gorgonella miniacea*, Studer; and *Gorgonella verriculata*, M.-Edw., extends as far into the Indian Ocean as the Mauritius; *Gorgonella orientalis* is found in the Pacific Ocean, at Japan.

*Verrucella*, Milne-Edwards.

The species of this genus are found in the Atlantic Ocean, *Verrucella granifera*, Köll., and *Verrucella ramosa*, Köll., being found off the coast of Africa (Köl liker), and *Verrucella guadalupensis*, D. and M., in the West Indies; *Verrucella candida*, Ridley, occurs in the Indian Ocean, at the Mauritius.

*Juncella*, Valenciennes.

The species of this genus are to be found in the temperate regions of all seas, and in several instances the area of distribution of the species is very extensive. *Juncella extans*, Verr., is recorded from the Azores; several species are found at the Antilles, and *Juncella hystrix* (Val.), has been taken at Bahia. In the Indian Ocean, we find *Juncella flexilis*, Std., *Juncella gemmacea* (Val.), and *Juncella rimen* (Val.), recorded from Bourbon and the Mauritius; *Juncella gemmacea* (Val.) from the Red Sea and from Australia; *Juncella ramosa* is found at Japan; *Juncella juncea* (Pallas), at Queensland.

*Ctenocella*, Valenciennes.

The only species of this genus, *Ctenocella pectinata* (Pallas), is recorded both from India and China (Gray), Moluccas (Lamarek), Torres Strait (Studer), Cuba (Ridley), Mermaid Straits, Australia (Studer).

*Phenilia*, Gray.

The locality from whence *Phenilia sanguinolenta*, Gray, was received is unknown.

*Heliana*, Gray.

*Heliana spinescens*, Gray, is recorded from the Philippines.

## Section II. SCLERAXONIA.

## Family I. BRIAREIDÆ.

*Leucoella*, Gray.

*Leucoella cervicornis*, Gray, has been found at Port Denison, Queensland.

*Solenocaulon*, Gray.

*Solenocaulon tortuosum*, Gray, and *Solenocaulon grayi*, Studer, have been found in North and North-west Australia ; *Solenocaulon tubulosum* (Genth) in the Philippines.

*Semperina*, Kölliker.

The only species of this genus, *Semperina rubra*, Kölliker, was found at Bohol.

*Suberia*, Studer.

*Suberia clavaria*, Std., was taken in the Atlantic, off Monte Video, while *Suberia köllikeri*, Std., occurred to the north of New Zealand, and *Suberia genthi* at Port Jackson.

*Anthothela*, Verrill.

The only species, *Anthothela grandiflora* (Sars.), originally described from Norway, has also been found by Verrill at Nova Scotia.

*Paragorgia*, Milne-Edwards.

*Paragorgia arborea* (Lin.), perhaps the largest of all the Alcyonaria, occurs on the coast of Norway, and in deep water at Setubal, off the coast of Portugal, and *Paragorgia nodosa*, Kor. and Dan., occurs off the coast of Norway.

*Briareum*, Blainville.

There is some doubt as to the species of this genus. Both *Briareum asbestinum*, Agass., and *Briareum plexaureum* (Lamx.), occur off Florida ; and *Briareum frielei*, Kor. and Dan., is found off Norway.

*Titanideum*, Agassiz.

*Titanideum suberosum* (Ellis and Sol.), the only species, has been found both at North and South Carolina.

*Iciligorgia*, Ridley.

Of the two species of this genus, *Iciligorgia schrammi* (D. and M.) has been found at Guadeloupe, and *Iciligorgia orientalis* (Ridley) at Torres Strait.

*Spongioderma*, Köl liker.

*Spongioderma verrucosum* (Möbius) = *Homophyton gattyæ*, Gray, the only species known, occurs at Algoa Bay (Möbius); near the Cape of Good Hope (Gray).

## Family II. SCLEROGORGIDÆ.

*Suberogorgia*, Gray.

*Suberogorgia suberosa* (Pallas), has a very wide distribution, being found in all three oceans; it has been found on the western coast of Africa and in the West Indies, then on the north-west coasts of Australia, the Mauritius, and at the Admiralty Islands; all the recorded stations are south of the Equator. *Suberogorgia verriculata* (Esper), has been found on the north-west coast of Australia and at Japan, while *Suberogorgia köllikeri* is now described from Japan.

*Keroeides*, Wright and Studer.

The only described species of this genus, *Keroeides koreni*, comes from Japan; if indeed it be the species described by Duchassaing and Michelotti as *Acis nutans* (D. and M.), the West Indies must be added as a habitat.

## Family III. MELITODIDÆ.

*Melitodes*, Verrill.

The somewhat numerous species of this genus would seem to be confined to the Australian and Pacific Ocean areas. There is, however, some difficulty in knowing what species to refer to the genus as we understand it. *Melitodes dichotoma* (Pall.),

*Melitodes rugosa*, *Melitodes rubeola*, and *Melitodes esperi* are found at Bass and Torres Straits and off Cape York. *Melitodes philippinensis* and *Melitodes sinuata* occur at the Philippines, *Melitodes lævis* and *Melitodes fragilis*<sup>1</sup> at Amboina, *Melitodes nodosa* at Japan, *Melitodes ochracea*, Verr., at Singapore, *Melitodes virgata*, Verr., at the Fijis.

*Mopsella*, Gray.

There is some doubt as to the species to be referred to this genus, but they seem to belong to the same geographical area as the previous one.

*Wrightella*, Gray.

The only species, *W. chrysanthus*, Gray, and *W. coccinea*, Gray, were found at the Seychelles. It is possible that *Mopsea erythræa*, Ehrb., belongs to this genus, if so the distribution must be extended to the Red Sea.

*Acabaria*, Gray.

The distribution is chiefly Australian; *Acabaria divaricata*, Gray, was found in Australia by Jukes, *Acabaria serrata*, Ridley, at Port Darwin, while *Acabaria japonica*, Verr., has been found both at Australia and Japan.

*Psilacabaria*, Ridley.

The only species of this genus, *Psilacabaria gracillima*, Ridley, has been found at Port Molle, Queensland, Port Darwin, and in East Australia.

*Clathraria*, Gray.

The habitat of the only species, *Clathraria rubrinodis*, Gray, is unknown.

*Parisis*, Verrill.

*Parisis fruticosa*, Verr., is found at Formosa, the Sulu Sea, Banda, and off the western coast of Australia. *Parisis laxa*, Verr., at Hong Kong, *Parisis minor* at Japan, *Parisis australis* at Port Jackson. *Parisis mauritiensis*, Rid., is the only species found extending into the Indian Ocean, at the Mauritius. We have regarded it as a variety of *Parisis fruticosa*, Verr.

<sup>1</sup> Vide Appendix, p. 275.



## Family IV. CORALLIDÆ.

*Corallium*, Lamarek.

*Corallium rubrum*, Lamk., is found in the Mediterranean and extends to the seas about the Cape Verde Islands; *Corallium stylasteroides*, Ridley, occurs at the Mauritius.

*Pleurocorallium*, Gray.

*Pleurocorallium secundum*, Dana, is probably found all over the Pacific, being recorded from Japan, Banda, the Ki Islands, and the Sandwich Islands. It has also been found off Prince Edward Island. *Pleurocorallium johnsoni*, Gray, occurs off Madeira.

## Order III. ALCYONACEA.

## Family I. HELIOPORIDÆ.

*Heliopora*, Blainville, *emend.* Moseley.

*Heliopora cærulea*, Blain., occurs from Singapore to Torres Strait in all suitable localities.

## Family II. NEPHTHYIDÆ.

*Gersemia*, Marenzeller.

*Duva*, Koren and Danielssen.

*Fulla*, Danielssen.

*Væringia*, Danielssen.

*Barathrobius*, Danielssen.

*Gersemiopsis*, Danielssen.

*Drifa*, Danielssen.

The various species of these genera have been found in the North Sea and in the waters of the Arctic Ocean.

*Eunephthya*, Verrill.

*Eunephthya lutkeni*, V. and M., comes from Greenland; *Eunephthya thyrsoides*, V., from the Cape of Good Hope; *Eunephthya nigra* (Pourt.), was dredged from a depth of 120 to 152 fathoms in the Strait of Florida, while the species found by the Challenger, *Eunephthya fusca*, was taken at a depth of 150 fathoms off Port Jackson.

*Nephthya*, Savigny; *Ammothea*, Savigny.

The species of these genera seem to be confined to the Red Sea and the Pacific Ocean.

*Spongodes*, Lesson.

The species have only been found in the Indian and the Pacific Oceans. In the former they have been found in the Red Sea, in the latter they have a very much extended range, occurring off Port Jackson, at the Fijis, Tahiti, then at the Philippines, off the coast of China and Japan, as far north as the Loochoo Islands. For a review of the distribution of the known species, see p. 225.

*Paranephthya*, Wright and Studer.

*Paranephthya capitulifera* has been found at the Admiralty Islands.

*Scleronephthya*, Wright and Studer.

The only species, *Scleronephthya pustulosa*, occurs at Japan.

*Chironephthya*, Wright and Studer.

The three species, *Chironephthya dipsacea*, *Chironephthya scoparia*, and *Chironephthya crassa*, were found at Japan.

*Siphonogorgia*, Kölliker.

The species of this genus would appear to be confined to the Pacific Ocean. *Siphonogorgia godeffroyi*, Köl., Pelew Islands; *Siphonogorgia köllikeri*, Amboina; *Siphonogorgia mirabilis*, Klunz, the Red Sea; *Siphonogorgia mirabilis*, Klunz, var. Rid., north-west coast of Australia, and *Siphonogorgia squarrosa*, Std., North-West Australia.

## Family III. ALCYONIDÆ.

*Bellonella*, Gray.

There is at present great difficulty in knowing what species to refer to this genus, so that the geographical distribution is not easily determined. The species are apparently of the temperate zone.

*Nidalia*, Gray.

Dr. Gray's habitat for the only species, *Nidalia occidentalis*, Gray, is "in littore Oceani Atlantici apud Montserrat in India Occidentali."

*Sarakka*, Danielssen ; *Crystallophanes*, Danielssen ; *Nannodendron*, Danielssen.

The species of these genera, quite recently described by Danielssen, are found in the North Sea.

*Paralcyonium*, Milne-Edwards.

*Paralcyonium elegans*, Milne-Edwards, is recorded from the coasts of Algiers.

*Alcyonium*, Linneus.

The species of this genus, as now restricted, are inhabitants of the temperate portions of all the three oceans.

*Lobularia*, Savigny.

The species of this genus, which is closely related to the last, seem to occupy the tropical portions of the three oceans, therein taking the place of the others.

*Sarcophytum*, Lesson, *emend.* Marenzeller.

The species are to be met with in all suitable localities in each of the oceans, but would appear not to be common in the Atlantic. They are found in the Red Sea, at Ceylon, the Andamans, on the coast of Australia, New Zealand, the Fiji and Tonga Islands. In the South Indian Ocean they occur at the Mauritius.

*Lobophytum*, Marenzeller.

The distribution is the same as in the last genus.

*Anthomastus*, Verrill.

*Anthomastus grandiflorus*, Verrill, was first dredged on the deep-water fishing banks, off Nova Scotia, since then it has been found off Martha's Vineyard, and in the Caribbean Sea ; *Anthomastus purpureus* (K. and D.), comes from the coast of Norway, Thronthjem ; of the two Challenger species, one *Anthomastus canariensis*, was dredged off the Canary Islands, while the second, *Anthomastus steenstrupi*, extends the geographical distribution into the North Pacific Ocean to Japan.

## Family IV. XENIIDÆ.

*Xenia*, Savigny.

The few species known of this genus would seem to be very widely scattered, occurring at the Fijis, Amboina, and in the Red Sea.

## Family V. ORGANIDÆ.

*Organidus*, Danielssen.

The only species described, *Organidus nordenskioldi*, Danielssen, was taken off the north-western coast of Spitzbergen.

## Family VI. TUBIPORIDÆ.

*Tubipora*, Linneus.

In the Indian Ocean the species are found in the Red Sea, and extending south of the Equator to the Seychelles; in the Pacific Ocean they have been found at most of the island groups, New Ireland, the Fijis, the Philippines, &c.

## Family VII. CORNULARIIDÆ.

*Cornularia*, Lamarck.

*Cornularia cornucopiæ*, Schweigger, perhaps the only known species, is recorded from the Mediterranean.

*Rhizoxenia*, Ehrenberg.

Species of this genus have been found on the coast of Norway (Sars), at Naples, and the Moluccas.

*Clavularia*, Quoy and Gaimard.

The now somewhat numerous species of this genus have been described as follows:— from the coasts of Norway, *Clavularia borealis*, K. and D., *Clavularia arctica*, K. and D., *Clavularia stormi*, K. and D., *Clavularia frigida*, Dan.; from the Mediterranean, *Clavularia crassa* (Mar. and Kow.), and *Clavularia petricola*, Mar.

and Kow.; from Vanikoro, *Clavularia viridis*, Q. and G., and *Clavularia violacea*, Q. and G.; Studer describes *Clavularia rosea*, Std., and *Clavularia magellanica*, Std., from Kerguelen and the Magellan Straits. Of the Challenger species, *Clavularia tubaria* was taken near Sombbrero, *Clavularia elongata* at Station 78, and *Clavularia cylindrica* from off Nightingale Island.

*Sarcodictyon*, E. Forbes.

The only species of this genus, *Sarcodictyon catenata*, Forbes, is apparently only known from the coasts of Scotland.

*Anthelia*, Savigny.

The *Anthelia glauca* of Savigny, with other species briefly described by Ehrenberg, are from the Red Sea; *Anthelia filippii*, Kolliker, is from Guadeloupe; while Studer describes *Anthelia capensis* from the Cape of Good Hope; *Anthelia desjardiana*, Templeton, is recorded from the Isle of France.

*Gymnosarca*, Saville Kent.

The only known species, *Gymnosarca bathybius*, S. Kent, was dredged off Cezimbra, Portugal.

*Cornulariella*, Verrill.

The single species of this genus is described by Verrill as found at Casco Bay, Bay of Fundy, Gulf of St. Lawrence.

*Telesto*, Lamouroux.

*Telesto aurantica*, Lamrx., *Telesto smithii*, Gray, and *Telesto trichostemma*, Dana, have been found on the coast of Australia, the last in Torres Strait; *Telesto arborea*, occurs at Station 190, north of Torres Strait, and south of Arrou Islands. *Telesto prolifera*, v. Koch, occurs in the East Indies; *Telesto ramulosa*, Verrill, at Hong Kong. *Telesto fruticulosus*, Dana, is recorded from the coast of the United States; *Telesto rupicola*, F. Müller, was found by Fritz Müller at Brazil and by the Challenger at Bahia, while *Telesto riisei*, Duch. and Mich., is from Guadeloupe. *Telesto trichostemma*, Dana, was first described from the Fiji Islands.

*Ceelogorgia*, Milne-Edwards.

The only known species, *Ceelogorgia palmosa*, Milne-Edwards, was described from a specimen taken at Zanzibar. Dr. C. Keller has since taken it at Nossi Bé, off the north-east coast of Madagascar, in the Mozambique Channel.

*Cyathopodium*, Verrill.

The genus was established by Verrill for *Aulopora tenuis* of Dana, found living at the "Paumotian" Archipelago.

*Scleranthelia*, Studer.

*Scleranthelia musica*, Studer, was found at lat. 15° 52' N., long. 23° 8' W.

*Anthopodium*, Verrill.

The only species is recorded from Fort Macon, north coast of North Carolina.

*Sympodium*, Ehrenberg.

*Sympodium norvegicum*, Kor. and Dan., *Sympodium abyssorum*, Dan., are found in the Northern Atlantic; *Sympodium coralloides* (Pall.), at Marseilles, Palermo, and in the Red Sea; *Sympodium armatum* was taken off the Bermudas; *Sympodium verrilli*, off Monte Video; and *Sympodium glomeratum*, at Nightingale Island. Of those species apparently peculiar to the Red Sea may be mentioned *Sympodium fulvum*, Forsk., *Sympodium caeruleum*, Ehrbg., *Sympodium fuliginosum*, Ehrbg., and *Sympodium purpurascens*, Ehrbg.

*Erythropodium*, Kölliker.

This genus was established for *Xenia carybæorum*, Duch. and Mich., which was taken in the Caribbean Sea.

*Callipodium*, Verrill.

This genus was founded by Verrill for two species (*Callipodium pacificum*, Verr., *Callipodium aureum*, Verr.) from Panama and Pearl Islands, and from Zorritos, Peru.

*Pseudogorgia*, Kölliker.

The remarkable species, *Pseudogorgia godeffroyi*, Kölliker, was taken in the Gulf of St. Vincent, Australia.

## Family VIII. HAIMEIDÆ.

*Haima*, Milne-Edwards.

*Haima funebris*, Milne-Edwards, was found off the coast of Algiers, not, as inadvertently mentioned by Hickson, at the Fiji Islands; *Haima hyalina*, Koren and Danielssen, off Thronthjem.

*Hartea*, Perceval Wright.

*Hartea elegans*, Perc. Wright, was found off the coast of Donegal at Rathmullen, in Ireland.

*Monoxenia*, Haeckel.

*Monoxenia darwini*, Haeckel, a small colony of this species was found in the interior of a dead *Cidaris*, from the Red Sea. Hickson has already called attention to the peculiar geographical distribution of these "isolated Alcyonaria."





## BATHYMETRICAL DISTRIBUTION.

In the preceding pages, one hundred and eighty-nine species of Alcyonaria are described as found during the voyage of the Challenger; of this number we have been unable to identify one hundred and thirty-three with already described forms.

In the following list the distribution in depth of one hundred and seventy-seven species is recorded; of which number one hundred and fifty-nine were found in depths of from "shallow water" to one of 600 fathoms, and but eighteen in depths of from 600 fathoms to one of 2300 fathoms.

As to the species from the great depths, it would seem premature to draw any conclusions from them as the record of the deep-sea Alcyonaria seems still to be very incomplete.

Reefs; shallow water, under 100 fathoms, but no precise depth mentioned.

<i>Acamptogorgia alternans</i> , reefs.	<i>Sarcophytum glaucum</i> , reefs.
<i>Melitodes philippinensis</i> , reefs.	<i>Heliopora cærulea</i> , reefs.
„ <i>sinuata</i> , reefs.	<i>Pseudoplexaura crassa</i> , shallow water.
„ <i>esperi</i> , reefs.	<i>Plexaura valenciennesi</i> , shallow water.
<i>Spongodes digitata</i> , reefs.	<i>Gorgonia flabellum</i> , shallow water.
„ <i>spicata</i> , reefs.	<i>Suberia genthi</i> , shallow water.
„ <i>spinosa</i> , reefs.	<i>Paranephthya capitulifera</i> , beach.
<i>Sarcophytum trocheliophorum</i> , reefs.	<i>Xenia elongata</i> , shallow water.
<i>Tubipora musica</i> , shallow water.	

Shallow water to 100 fathoms.

<i>Plexauroides prælonga</i> , 8 fathoms.	<i>Spongodes macrospina</i> , 10 fathoms.
<i>Leptogorgia torresia</i> , 8 fathoms.	„ <i>florida</i> , 10 fathoms.
<i>Juncella gemmacea</i> , 8 fathoms.	„ <i>anguina</i> , 10 fathoms.
<i>Ellisella maculata</i> , 8 fathoms.	„ <i>bicolor</i> , 10 fathoms.
<i>Echinogorgia pseudosassapo</i> , 8 fathoms.	„ <i>heterocyathus</i> , 10 fathoms.
<i>Telesto arborea</i> , 9 fathoms.	„ <i>coronata</i> , 10 fathoms.

- Telesto rupicola*, 10 to 20 fathoms.  
*Juncella juncea*, var., 7 to 11 fathoms.  
*Spongodes umbellata*, 11 fathoms.  
*Platycaulos danielsseni*, 14 fathoms.  
*Telesto trichostemma*, 3 to 11 fathoms.  
*Plexaurella philippinensis*, 18 fathoms.  
*Scleronephthya pustulosa*, 18 fathoms.  
*Sarcophytum tongatabuensis*, 18 fathoms.  
 „ *philippinensis*, reef, 18 fathoms.  
*Muricea bicolor*, 10 to 20 fathoms.  
*Echinomuricea indomalaccensis*, 20 fathoms.  
*Muricella gracilis*, 16 to 20 fathoms.  
*Spongodes dendrophytum*, 20 fathoms.  
 „ *nephthyaformis*, 25 fathoms.  
*Melitodes laevis*, 15 to 25 fathoms.  
 „ *fragilis*, 15 to 25 fathoms.  
*Elasmogorgia filiformis*, 28 fathoms.  
*Spongodes corymbosa*, 28 fathoms.  
 „ *monticularis*, 28 fathoms.  
*Mopsea dichotoma*, 35 fathoms.  
*Acanthoisis flabellum*, 35 fathoms.  
*Parisia australiensis*, 35 fathoms.  
*Mopsea encrinura*, 38 fathoms.  
*Muricella umbraticoides*, 40 fathoms.  
*Melitodes rugosa*, 40 fathoms.  
*Muricella crassa*, 49 fathoms.  
*Melitodes rubicola*, 49 fathoms.  
*Euplexaura parviclados*, 8 to 50 fathoms.  
 „ *pinnata*, 8 to 50 fathoms.  
*Subergorgia suberosa*, 5 to 50 fathoms.  
*Thouarella affinis*, 55 fathoms.  
*Alcyonium sollasi*, 55 fathoms.  
*Sarcophytum atlanticum*, 60 fathoms.  
*Lobophytum marenzelleri*, 60 to 70 fathoms.  
*Spongodes carnea*, 3 to 70 fathoms.  
 „ *pustulosa*, 30 to 70 fathoms.  
 „ *cervicornis*, 30 to 70 fathoms.  
*Alcyonium antarcticum*, 75 fathoms.  
*Primnoisis ambigua*, 10 to 80 fathoms.  
*Placogorgia atlantica*, 80 fathoms.  
*Ceratoisis philippinensis*, 82 fathoms.  
*Primnoisis sparsa*, 85 fathoms.  
*Scirpearella moniliforme*, 100 fathoms.

Between 100 fathoms and 300 fathoms.

- Primnoella grandisquama*, 120 fathoms.  
*Echinogorgia ramulosa*, 120 fathoms.  
*Parisia fruticosa*, 129 fathoms.  
*Dasygorgia cupressina*, 140 fathoms.  
*Thouarella hilgendorfi*, 140 fathoms.  
*Plumarella delicatissima*, 140 fathoms.  
*Caligorgia sertosa*, 140 fathoms.  
*Acanthogorgia ridleyi*, 140 fathoms.  
*Acanthomuricea argentea*, 140 fathoms.  
*Spongodes collaris*, 140 fathoms.  
 „ *laxa*, 140 fathoms.  
 „ *rhodosticta*, 140 fathoms.  
*Villogorgia intricata*, 145 fathoms.  
*Eunicella papillosa*, 145 fathoms.  
*Muricella tenera*, 145 fathoms.  
*Amphilaphis regularis*, 150 fathoms.  
*Primnoella australiensis*, 7 to 150 fathoms.  
*Scirpearella gracilis*, 7 to 150 fathoms.  
 „ *profunda*, 7 to 150 fathoms.  
*Corallium rubrum*, 25 to 150 fathoms.  
*Eunephthya fusca*, 150 fathoms.  
*Clavularia cylindrica*, 100 to 150 fathoms.  
*Sympodium glomeratum*, 100 to 150 fathoms.  
*Acanella chiliensis*, 175 fathoms.  
*Primnoella biserialis*, 175 fathoms.  
*Leptogorgia arbuscula*, 175 fathoms.  
*Alcyonium haddoni*, 175 fathoms.  
*Clematissa obtusa*, 245 fathoms.  
*Acis pustulosa*, 232 fathoms.

## Between 300 and 600 fathoms.

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|---|---|
| <i>Dasygorgia flexilis</i> , 307 fathoms.             | <i>Thouarella köllikeri</i> , 175 to 400 fathoms. |
| <i>Primnoisis antarctica</i> , 310 fathoms.           | <i>Acanthogorgia laxa</i> , 400 fathoms.          |
| <i>Stenella spinosa</i> , 310 fathoms.                | <i>Clematissa robusta</i> , 400 fathoms.          |
| <i>Thouarella variabilis</i> , 150 to 310 fathoms.    | <i>Leptogorgia purpurea</i> , 10 to 400 fathoms.  |
| <i>Primnoides sertularoides</i> , 310 fathoms.        | <i>Chironephthya dipsacea</i> , 345 fathoms.      |
| <i>Acanthogorgia ramosissima</i> , 310 fathoms.       | „ <i>scoparia</i> , 345 fathoms.                  |
| <i>Lophogorgia lutkeni</i> , 310 fathoms.             | „ <i>crassa</i> , 345 fathoms.                    |
| <i>Pleurocorallium secundum</i> , 129 to 310 fathoms. | <i>Dasygorgia melanotrichos</i> , 420 fathoms.    |
| <i>Strophogorgia petersi</i> , 345 fathoms.           | <i>Stenella johnsoni</i> , 420 fathoms.           |
| <i>Dasygorgia geniculata</i> , 82 to 345 fathoms.     | <i>Callistephanus koreni</i> , 430 fathoms.       |
| <i>Ceratoisis paucispina</i> , 345 fathoms.           | <i>Acanella eburnea</i> , 450 fathoms.            |
| <i>Caligorgia flabellum</i> , 345 fathoms.            | <i>Juncella racemosa</i> , 450 fathoms.           |
| <i>Acanthogorgia arbuscula</i> , 345 fathoms.         | <i>Bellonella bocagei</i> , 450 fathoms.          |
| <i>Muricella complanata</i> , 345 fathoms.            | <i>Clavularia tubaria</i> , 450 fathoms.          |
| „ <i>perramosa</i> , 345 fathoms.                     | <i>Dasygorgia squarrosa</i> , 500 fathoms.        |
| „ <i>nitida</i> , 345 fathoms.                        | „ <i>expansa</i> , 520 fathoms.                   |
| <i>Scirpearella rubra</i> , 345 fathoms.              | <i>Thouarella antarctica</i> , 550 fathoms.       |
| <i>Juncella barbadensis</i> , 345 fathoms.            | <i>Primnoella distans</i> , 120 to 550 fathoms.   |
| <i>Gorgonella orientalis</i> , 345 fathoms.           | <i>Strophogorgia verrilli</i> , 565 fathoms.      |
| <i>Suberogorgia verriculata</i> , 345 fathoms.        | <i>Anthomastus steenstrupi</i> , 565 fathoms.     |
| „ <i>köllikeri</i> , 345 fathoms.                     | <i>Dasygorgia spiculosa</i> , 334 to 573 fathoms. |
| <i>Keroides koreni</i> , 345 fathoms.                 | „ <i>acanthella</i> , 600 fathoms.                |
| <i>Melitodes nodosa</i> , 345 fathoms.                | „ <i>axillaris</i> , 82 to 600 fathoms.           |
| <i>Parisis minor</i> , 345 fathoms.                   | <i>Primnoisis rigida</i> , 600 fathoms.           |
| <i>Acanella rigida</i> , 200 to 360 fathoms.          | <i>Calyptrophora wyvillei</i> , 600 fathoms.      |
| <i>Clematissa verrilli</i> , 360 fathoms.             | <i>Stachyodes regularis</i> , 600 fathoms.        |
| <i>Muriceides fragilis</i> , 375 fathoms.             | <i>Stenella acanthina</i> , 600 fathoms.          |
|   | <i>Thouarella moseleyi</i> , 600 fathoms.         |
|   | <i>Thouarella murrayi</i> , 600 fathoms.          |

## Between 600 and 1200 fathoms.

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|--|--|
| <i>Sympodium verrilli</i> , 600 fathoms.       | <i>Acanthogorgia longiflora</i> , 700 fathoms. |
| <i>Ceratoisis grandiflora</i> , 610 fathoms.   | <i>Clavularia elongata</i> , 1000 fathoms.     |
| <i>Calyptrophora japonica</i> , 610 fathoms.   | <i>Sympodium armatum</i> , 1075 fathoms.       |
| <i>Stenella gigantea</i> , 210 to 610 fathoms. | <i>Ceratoisis palmæ</i> , 1125 fathoms.        |

Between 1200 and 1500 fathoms, no species found.

Between 1500 and 1600 fathoms.

*Acanella arbuscula*, 1525 fathoms. | *Anthomastus canariensis*, 1525 fathoms.

Between 1600 and 1700 fathoms.

*Strophogorgia fragilis*, 1675 fathoms. | *Callozostron mirabilis*, 1675 fathoms.  
*Acanella simplex*, 1675 fathoms. | *Telesto rigida*, 1675 fathoms.

Between 1700 and 1800 fathoms, no species found.

Between 1800 and 1900 fathoms.

*Dasygorgia japonica*, 1875 fathoms. | *Stenella doederleini*, 1875 fathoms.

Between 1900 and 2100 fathoms, no species found.

Between 2100 and 2200 fathoms.

*Pleurocorallium johnsoni*, 1725 to 2200 fathoms.

Between 2200 and 2300 fathoms.

*Bathygorgia profunda*, 2300 fathoms.

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*Calypterinus alimani*, reefs. | *Ceratoisis nuda*, reefs.

There is every reason to believe that these two species are deep-sea forms; possibly they may have been taken in deep water, off the reefs, from whence they are recorded.

# INDEX.

- Acabaria*, xxxvi, 171, 181, 292.  
*divaricata*, Gray, 292.  
*japonica*, Verrill, 292.  
*serrata*, Ridley, 292.
- Acamptogorgia*, lv, 93, 121, 115, 284.  
*alternans*, n. sp., 117, 284.  
*arbuscula* (Gray), 116, 284.  
*? bebrycoides* (Koch), 284.
- Acanella*, xliii, 25, 26, 29, 279.  
*arbuscula* (Yate Johnson), 30, 279.  
*chiliensis*, n. sp., 31, 279.  
*eburnea* (Pourtales), 30, 279.  
*gregorii* (Gray), 279.  
*normani*, Verrill, 30, 279.  
*rigida*, n. sp., 31, 279.  
*simplex*, Verrill, 32, 279.  
*spiculosa*, Verrill, 30.
- Acanelladæ*, xli, 24, 25.
- Acanthogorgia*, ix, lii, 93, 282.  
*armata*, Verrill, 282.  
*aspera*, Pourtales, 282.  
*atlantica*, Yate Johnson, 93.  
*grayi*, Yate Johnson, 93.  
*hirsuta*, Gray, 282.  
*hirta*, Pourtales, 93.  
*johnsoni*, Studer, 93.  
*laxa*, n. sp., 96, 282.  
*longiflora*, n. sp., 94, 282.  
*muricata*, Verrill, 282.  
*ramosissima*, n. sp., 97, 282.  
*ridleyi*, n. sp., 95, 282.  
*schrammi* (Duchassaing and Michelotti), 96, 282.
- Acanthoisis*, xlv, 34, 44, 280.  
*flabellum*, n. sp., 45, 280.
- Acanthoptilum*, xxviii.
- Acis*, lvi, 93, 121, 284.  
*guadalupensis*, Duchassaing and Michelotti, 122, 168, 284.
- Acis nutans*, Duchassaing and Michelotti, 122, 169, 292.  
*orientalis*, Ridley, 122, 284.  
*pustulata*, n. sp., 122, 284.
- Alcyonacea*, ix, 187, 293.
- Alcyonaria*, x, 1, 277.
- Alcyonidæ*, x, xviii, 238, 294.
- Alcyoninæ armes*, xxii.
- Alcyoninæ capitulifera*, xxii, 188.
- Alcyonium*, viii, xx, 189, 191, 238, 295.  
*antarcticum*, n. sp., 239.  
*floridum*, Esper, 192.  
*glomeratum*, Lütken, 190.  
*gorgonoides*, Ellis and Solander, 270.  
*haddoni*, n. sp., 240.  
*sollasi*, n. sp., 240.
- Alexella*, xiv, 259, 262.  
*smithii*, Gray, 259.
- Ammothæa*, xxiii, xxiv, xxv, 189, 293.
- Amphilaphis*, xlix, 53, 70, 287.  
*regularis*, n. sp., 71, 281.
- Anthelia*, vii, ix, xi, xii, xiv, xvi, xvii, 253, 297.  
*capensis*, Studer, 297.  
*desjardiana*, Templeton, 297.  
*filippi*, Kolliker, 297.  
*glauca*, Savigny, 297.
- Anthogorgia*, li, liii, 285.  
*divaricata*, Verrill, 285.
- Anthomastus*, xviii, xx, xxi, 238, 242, 295.  
*canariensis*, n. sp., 242, 295.  
*grandiflorus*, Verrill, 242, 295.  
*purpureum* (Koren and Danielssen), 244, 295.  
*steenstrupi*, n. sp., 243, 295.
- Anthomuricea*, li, liii, 93, 103, 283.  
*argentea*, n. sp., 104, 283.  
*chamæleon* (Koch), 283.
- Anthopodium*, xiii, xv, xvi, 254, 298.
- Anthoptilum*, xxviii.
- Anthothela*, xxxi, xxxiii, 291.

- Anthothela grandiflora*, Sars, 291.  
*Antipathes flabellum*, Esper, 118.  
*Astrogorgia*, li, lv.  
     *sinensis*, Verrill, 286.  
*Aulopora*, x, xv.  
     *tenuis*, Dana, xii.  
*Axifera*, viii, xxix.  
*Barathrobis*, xxiii, 189, 294.  
*Bathygorgia*, viii, xlii, 26, 32, 279.  
     *profunda*, Perceval Wright, 32, 279.  
*Bathyptilum*, xxviii.  
*Bebryce*, lv, 286.  
     *mollis*, Phillipi, 286.  
*Bellonella*, xviii, xix, xxi, 189, 238, 241, 294.  
     *bocagei*, Saville Kent, 241.  
*Bellonelladæ*, xviii.  
*Blepharogorgia*, lii, 93.  
     *schrammi*, Duchassaing and Michelotti, 96.  
*Boarella flabellata*, Gray, 99, 110.  
*Bovella ramulosa*, Gray, 120.  
*Brandella*, liii.  
     *intricata*, Gray, 99, 110, 111.  
*Briarea*, 164.  
*Briareaceæ*, xxxi.  
*Briareidæ*, viii, ix, xvi, 162, 290.  
*Briareinæ*, xxxi, 162.  
*Briareum*, xxxi, xxxiii, 290.  
     *asbestinum*, Agassiz, 290.  
     *frielei*, Koren and Danielssen, 290.  
     *plexaurum* (Lamouroux), 290.  
*Caligorgia*, l, 53, 75, 281.  
     *compressa* (Verrill), 80, 281.  
     *flabellum* (Ehrenberg), 79, 281.  
     *gracilis* (Milne-Edwards), 78, 281.  
     *sertosa*, n. sp., 77, 281.  
     *ventilabrum*, Studer, 78, 281.  
     *verticillata*, Gray, 80, 281.  
     *verticillata* (Pallas), 78?  
*Callicella*, 76, 154.  
     *elegans*, Gray, 79.  
*Calligorgia*, 75, 76.  
*Calligorgiadæ*, xlv, lxiv, 46.  
*Callipodium*, vii, xii, xiii, xvi, 253, 298.  
     *aureum*, Verrill, 298.  
     *pacificum*, Verrill, 298.  
*Callisis*, xliii, 279.  
     *flexibilis* (Pourtales), 279.  
*Callistephanus*, lxii, 148, 287.  
     *koreni*, n. sp., 149, 287.  
*Callogorgia*, 75.  
*Callogorgia penna*, Milne-Edwards, 76.  
*Callozostrom*, xlvii, 48, 280.  
     *mirabilis*, Perceval Wright, 48, 280.  
*Callozostroninæ*, xlv, 47.  
*Calypterinus*, xlviii, 53, 280.  
     *allmani*, n. sp., 53, 280.  
*Calyptrophora*, xlvii, 49, 50, 280.  
     *japonica*, Gray, 50, 280.  
     *josephinæ*, Lindström, 56.  
     *wyvillei*, n. sp., 52, 280.  
*Calyptrophoridæ*, xlv, 46, 49.  
*Calyptrophorinæ*, xlvii, 47, 49.  
*Carijoa*, xii, xiv, 259.  
     *arborea*, n. sp., 262.  
     *prolifera*, v. Koch, 262.  
     *riisei*, Duchassaing and Michelotti, 262.  
     *rupicola*, F. Müller, 259, 262.  
     *smithii*, Gray, 262.  
     *trichostemma* (Dana), 262, 264.  
*Cavernularia*, xxix.  
*Ceratoisidæ*, xlii, 24, 25.  
*Ceratoisidinæ*, xlii, 25, 278.  
*Ceratoisis*, ix, xlii, 25, 26, 278.  
     *caryophyllia*, Verrill, 278.  
     *grandiflora*, Studer, 26, 27, 279.  
     *grayi*, Perceval Wright, 26, 27, 278.  
     *japonica*, Studer, 279.  
     *longiflora*, Verrill, 278.  
     *nuda*, n. sp., 28, 279.  
     *ornata*, Verrill, 278.  
     *palma*, n. sp., 29, 278.  
     *paucispina*, n. sp., 28, 279.  
     *philippinensis*, n. sp., 27, 279.  
     *siemensii*, Studer, 278.  
     *vitrea*, Verrill, 278.  
*Cereopsis*, xix, xxi, 241.  
     *bocagei*, Saville Kent, xxi, 241.  
*Cespitularia*, xvii.  
*Chironephthya*, xxiii, xxvi, 189, 230, 294.  
     *crassa*, n. sp., 234, 294.  
     *dipsacea*, n. sp., 231, 294.  
     *scoparia*, n. sp., 232, 294.  
*Chrysogorgia*, l, 5, 23, 278.  
     *desbonni*, Duchassaing and Michelotti, l, 23, 278.  
     *desbonni* (Verrill), l.  
     *fewkesi*, Verrill, l, 23, 24, 278.  
*Chrysogorgidæ*, xl, l, 4, 5.  
*Chrysogorginæ*, xl, 2, 4.  
*Cladiscus*, xxviii.  
*Clathraria*, xxxvii, 293.

- Clathraria rubrinodis*, Gray, 292.  
*Clavella*, xxix.  
*Clavularia*, vii, xii, xiii, xiv, xvi, 253, 254, 259, 296.  
     *arctica*, Koren and Danielssen, 255, 296.  
     *borealis*, Koren and Danielssen, 255, 296.  
     *crassa* (Milne-Edwards), 255.  
     *crassa*, Marion and Kowalevsky, 296.  
     *cylindrica*, n. sp., 258, 297.  
     *elongata*, n. sp., 257, 297.  
     *frigida*, Dana, 255, 296.  
     *magellanica*, Studer, 297.  
     *petricola*, Kowalevsky and Marion, 255, 296.  
     *prolifera*, Duchassaing and Michelotti, 255.  
     *prolifera*, v. Koch, 259.  
     *rissei*, Duchassaing and Michelotti, 255, 297.  
     *rosea*, Studer, 255, 297.  
     *rupicola*, F. Müller, xii.  
     *stormi*, Koren and Danielssen, 255, 296.  
     *tubaria*, n. sp., 256, 297.  
     *violacea*, Quoy and Gaimard, 255, 297.  
     *viridis*, Quoy and Gaimard, 255, 297.  
*Clematissa*, liii, 93, 106, 283.  
     *obtusa*, n. sp., 108, 283.  
     *robusta*, n. sp., 108, 283.  
     *verrilli*, n. sp., 107, 283.  
*Cælogorgia*, xii, xiii, xiv, xvi, 253, 265, 298.  
     *palmosa* (Valenciennes), 266, 298.  
*Corallidæ*, xxxvii, 185, 293.  
*Corallinæ*, xxxvii, 185.  
*Corallium*, viii, x, xxxvii, 185, 293.  
     *nobile*, Linnæus, 185.  
     *rubrum*, Lamarck, 185, 293.  
     *stylasteroides*, Ridley, 293.  
*Cornularia*, vii, xii, xiii, xvi, xvii, 253, 296.  
     *cornucopiæ*, Schweigger, 296.  
     *crassa*, Milne-Edwards, 255.  
*Cornulariadæ*, xi, 252.  
*Cornulariella*, xii, xiv, xvi, 297.  
*Cornulariidæ*, ix, xi, 252, 296.  
*Cricogorgia ramea*, Milne-Edwards, 73, 74.  
*Crystallophanes*, xix, 295.  
*Ctenocella*, lxvi, 289.  
     *pectinata* (Pallas), 289.  
*Cyathopodium*, xii, xiii, xv, xvi, 298.  
*Danielssenia*, lxiii, 288.  
     *irramosa*, Grieg, 288.  
*Dasygorgia*, x, xl, 1, 5, 6, 7, 278.  
     *acanthella*, n. sp., 18, 278.  
     *agassizi*, Verrill, 13, 278.  
     *axillaris*, n. sp., 20, 278.  
     *Dasygorgia cupressa*, n. sp., 11, 278.  
     *elegans*, Verrill, 13, 278.  
     *expansa*, n. sp., 16, 278.  
     *flexilis*, n. sp., 10, 278.  
     *geniculata*, n. sp., 17, 278.  
     *japonica*, n. sp., 21, 278.  
     *malanotrichus*, n. sp., 15, 278.  
     *spiculosa*, Verrill, 9, 278.  
     *splendens*, Verrill, 16, 278.  
     *squamata*, Verrill, 16, 278.  
*Dasygorgidæ*, ix, xxxix, 1.  
*Distichoptilum*, xxix.  
*Drifa*, xxiii, xxiv, 189, 293.  
*Dubenia*, xxviii.  
*Duva*, xxiii, xxix, 189, 293.  
*Echinogorgia*, li, liv, 93, 118, 284.  
     *aurantiaca* (Milne-Edwards), 284.  
     *cancellata* (Verrill), 284.  
     *cerea* (Esper), 284.  
     *flabellum* (Esper), 120, 284.  
     *furfuracea* (Esper), 11, 284.  
     *intermedia*, Studer, 118, 284.  
     *pseudo-sassapo*, Kölliker, 119, 284.  
     *ramulosa* (Gray), 120, 284.  
     *umbratica* (Esper), 284.  
*Echinomuricea*, li, liv, 93, 112, 283.  
     *coccinea* (Stimpson), 112, 283.  
     *indomalaccensis*, Ridley, 112, 283.  
*Elasma*, lvi.  
*Elasmogorgia*, lvi, 93, 132, 285.  
     *filiformis*, n. sp., 133, 285.  
*Ellisella*, lv, lvi, 154, 160, 289.  
     *calamus*, Studer, 160.  
     *gemmacea* (Valenciennes), 158.  
     *maculata*, Studer, 160.  
*Elliselladæ*, xxxv, lxiv, 154, 170.  
*Erythropodium*, vii, xii, xiii, xv, xvi, 253, 298.  
     *carybæorum*, Duchassaing and Michelotti, 298.  
*Eugorgia*, lxiii, 288.  
*Eumuricea*, lvi, 123, 133, 286.  
     *acervata*, Verrill, 286.  
     *hispidia*, Verrill, 286.  
     *horrida*, Möbius, 286.  
     *squarrosa*, Verrill, 286.  
     *tubigera*, Verrill, 286.  
*Eunephthya*, xxiii, xxiv, 189, 190, 293.  
     *fusca*, n. sp., 190, 293.  
     *lutkeni*, Verrill, 190, 293.  
     *nigra* (Pourtales), 190, 293.  
     *thyrsoides*, Verrill, 190, 293.

- Eunicea*, lvii, lviii, 135.  
     *humilis*, Milne-Edwards, 134.  
*Euniceidæ*, lvii, 135.  
*Eunicella*, lvii, lix, 136, 145, 286.  
     *papillosa* (Esper), 145.  
     *tenuis*, Verrill, 286.  
*Eunoella*, 270.  
     *gorgonides* (Gray), 270.  
*Euplexaura*, lvii, lix, 136, 143.  
     *capensis*, Verrill, 136, 143.  
     *parciclados*, n. sp., 144.  
     *pinnata*, n. sp., 144.  
*Evagora*, xiii.  
*Fanellia*, 76.  
     *compressa*, Gray, 80.  
Favositidæ, vi.  
*Filigella gracilis*, Gray, 132.  
*Fulla*, xxiii, 189, 294.  
*Funiculina cylindrica*, Lamarek, 154.  
*Funiculus*, xxviii.  
*Gersemia*, xxiii, xxiv, 189, 294.  
*Gersemiopsis*, xxiii, xxiv, 189, 294.  
*Godefroyia*, xxvii.  
*Goendul*, xxix.  
Gorgonacea, vi, x, xxix, 1.  
*Gorgonella*, lxvi, 161, 284.  
     *distans*, Studer, 284.  
     *miniacea*, Studer, 284.  
     *orientalis*, n. sp., 161, 284.  
     *verriculata*, Studer, 284.  
Gorgonellaceæ, lxiv, 153.  
Gorgonellidæ, lxiv, 153.  
*Gorgonia*, lxi, lxiii, 153, 287.  
     *albicans*, K  liker, lix.  
     *antipathes*, Esper, 142.  
     *cancellata*, Dana, 118.  
     *cerea*, Esper, 118.  
     *crassa*, Ellis and Solander, 142.  
     *dichotoma*, Esper, 135.  
     *elongata*, Pallas, 160.  
     *exserta*, Ellis and Solander, 146.  
     *flabellum*, Linneus, 153.  
     *flammea*, Ellis and Solander, lxii, 150, 151.  
     *fucosa*, Valenciennes, lix, 136.  
     *furfuracea*, Esper, 118.  
     *gemmacea*, Valenciennes, 158.  
     *junceæ*, Pallas, 158, 160.  
     *moniliforme*, Lamarek, 151.  
     *palma*, Esper, 150.  
     *palma*, Pallas, lix, 151.  
*Gorgonia palma*, var. *alba*, Esper, lix.  
     *pectinata*, Pallas, 160.  
     *penna*, Lamarek, 73, 74.  
     *porosa*, Esper, 142.  
     *punicea*, Valenciennes, 151.  
     *purpurea*, Pallas, 151.  
     *reticulata*, Ellis and Solander, 167.  
     *richardi*, Duchassaing and Michelotti, 147.  
     *sassapo*, Esper, 118.  
     *sassapo*, var. *reticulata*, Esper, 118, 119.  
     *suberosa*, Ellis, 164, 165.  
     *suberosa*, Pallas, 166.  
     *trichostemma*, Dana, 259, 268.  
     *umbratica*, Esper, 118.  
     *vermiculata*, Lamarek, 142.  
     *verriculata*, Esper, 165, 167.  
     *verrucosa*, Pallas, 136, 145.  
     *verticillaris*, Esper, 76, 79.  
     *verticillaris*, Ellis and Solander, 78.  
     *verticillata*, Pallas, 75, 78.  
Gorgoniaceæ, lx, 146.  
Gorgonidæ, xxix, lx, 146.  
*Gunneria*, xxix.  
*Gymnosarca*, xii, xiv, xvi, 254, 297.  
     *bathybius*, Saville Kent, 297.  
*Haimea*, xi, xvi, 299.  
     *funnebris*, Milne-Edwards, 299.  
     *hyalina*, Koren and Danielssen, 299.  
Haimeidæ, xi, xvi, 299.  
*Halcyonium*, xx.  
*Halipterus*, xxviii.  
*Halisceptrum*, xxvii.  
*Hartea*, xi, 299.  
     *elegans*, Perceval Wright, 299.  
*Heliana*, lxvii, 289.  
     *spinescens*, Gray, 289.  
*Heliopora*, ix, x, xxvii, 187, 294.  
     *c  rulea*, Blainville, 187, 293.  
Helioporid  , vi, x, xxvi, 187.  
*Herophila*, xli, 153, 278.  
     *regia*, Steenstrup, 278.  
*Heterogorgia*, lv, 286.  
     *tortuosa*, Verrill, 286.  
     *verrucosa*, Verrill, 286.  
Heteroxenia, xvii.  
Holaxonia, viii, ix, x, xvi, xxxviii.  
*Homophyton*, xxxiv.  
     *gatty  *, Gray, 291.  
*Hymenogorgia*, lxiii, 288.  
*Hypnogorgia*, lii.



- Hypnogorgia pendula*, Duchassaing and Michelotti, 285.
- Iciligorgia*, xxxiv, 164, 291.  
*orientalis*, Ridley, 164, 291.  
*schrammi* (Duchassaing and Michelotti), 164, 291.
- Iphethyrus*, xix, 189, 241.  
*speciosus*, W. Koch, xxi, 241.
- Iridigorgia*, xl, 4, 5, 6, 278.  
*pourtalezi*, Verrill, 6, 278.
- Isidæ*, xli, 24.
- Isidella*, xliv.  
*capensis*, Studer, 279.  
*eburnea*, Gray, 30.  
*neapolitana*, v. Koch, xlv, 279.
- Isis*, xlii, xlv, 24, 171, 185, 280.  
*antarctica*, Studer, 35.  
*capensis*, Studer, 279.  
*coralloides*, Lamarck, xlv.  
*dichotoma*, Linneus, 41, 171, 173.  
*elongata*, Esper, xlv.  
*encrinura*, Lamarck, 43.  
*gracilis*, Lamouroux, xlv.  
*hippuris*, Linneus, 280.  
*nobilis*, Linneus, 185.
- Juncella*, lxv, 141, 154, 158, 289.  
*barbadensis*, Duchassaing and Michelotti, 154, 159.  
*extans*, Verrill, 289.  
*flexilis*, Studer, 159, 289.  
*junculina*, Duchassaing and Michelotti, 154, 159.  
*gemmacea* (Valenciennes), 158, 289.  
*hystrix* (Valenciennes), 289.  
*juncea*, Valenciennes, 140, 158.  
*juncea* (Pallas), var. *alba*, nov., 158, 289.  
*racemosa*, n. sp., 159, 289.  
*vetusta*, Kölliker, 80.  
*vimen* (Valenciennes), 289.
- Keratoisidæ*, xli, 24, 25, 26.
- Keratoisis*, 26.
- Keroeides*, xxxv, 168, 291.  
*koreni*, n. sp., 169, 291.
- Kophobelemnon*, xxviii.
- Leiopathes vetusta*, Michelotti, 80.
- Lemnaliadæ*, xxii, 188.
- Lepidisis*, xliii, 26, 279.  
*caryophyllia*, Verrill, 279.  
*longiflora*, Verrill, 279.  
*vitrea*, Verrill, 279.
- Leptogorgia*, lxi, lxii, 150, 287.  
*adamsi*, Verrill, 287.  
*arbuscula* (Philippi), 152, 287.
- Leptogorgia arenata* (Valenciennes), 287.  
*aurantiaca*, Milne-Edwards, 118.  
*australiensis*, Ridley, 153, 287.  
*californica*, Verrill, 287.  
*cuspidata*, Verrill, 287.  
*diffusa*, Verrill, 287.  
*flexilis*, Verrill, 287.  
*floridana*, Verrill, 287.  
*miniata*, Verrill, 287.  
*peruana*, Verrill, 287.  
*pinnata* (Linneus), 287.  
*pumicea*, Verrill, 151, 287.  
*purpurea* (Pallas), 151, 287.  
*ramulus* (Valenciennes), 287.  
*rigida*, Verrill, 287.  
*sarmentosa* (Esper), 287.  
*stenobranchis*, Verrill, 287.  
*teres*, Verrill, 287.  
*torresia*, n. sp., 152, 287.  
*viminalis* (Pallas), 287.  
*webbiana* (Valenciennes), 287.
- Leptoptilum*, xxix.
- Leucoella*, xxxv, 290.  
*cervicornis*, Gray, 290.
- Lithoprismoa*, xlviii.
- Lituarina*, xxix.
- Lobophytum*, x, xviii, xx, xxi, 238, 250, 295.  
*marenzelleri*, n. sp., 251.
- Lobularia*, viii, xviii, xx, 238, 295.  
*palmosa*, Valenciennes, 266.
- Lophogorgia*, lxi, 150, 287.  
*crista*, Möbius, lxii.  
*lutkeni*, n. sp., 150.
- Lygomorpha*, xxix.
- Madrepora rubra* (Linneus), 185.
- Massarella*, 270.
- Melitæa*, xxxvi, 24, 170, 171.
- Melitella*, xxxvi, 171.
- Melithæa*, 171.
- Melithæaceæ*, xxxv, xli, 24, 170.
- Melithæadæ*, xxxv, 170.
- Melithæidæ*, xxxv, 170.
- Melitodes*, xxxvi, 170, 171, 291.  
*dichotoma* (Pallas), 173, 291.  
*esperi*, n. sp., 179, 292.  
*fragilis*, n. sp., 179, 275, 292.  
*lævis*, n. sp., 179, 292.  
*nodosa*, n. sp., 178, 292.  
*ochracea*, Verrill, 292.  
*philippinensis*, n. sp., 176, 292.

- Melitodes rubeola*, n. sp., 175, 292.  
*rubeola*, n. sp., var., 176, 292.  
*rugosa*, n. sp., 174, 292.  
*sinuata*, n. sp., 177, 292.  
*virgata*, Verrill, 292.  
 Melitodidæ, xxxv, 170, 292.  
*Menacella*, lv, 285.  
*arbuscula*, Gray, 116.  
*reticularis*, Gray, 116, 285.  
*Menella indica*, Gray, liii, 285.  
*Microptilum*, xxix.  
*Monilia annulata*, Valenciennes, 80.  
*Monoxenia*, xi, 299.  
*darwini*, Haeckel, 299.  
 Monoxenidæ, xi.  
*Mopsea*, xxxvi, xlv, 24, 25, 40, 280.  
*arbuscula*, Yate Johnson, 29, 30.  
*bicolor*, Köl liker, 175.  
*costata*, Milne-Edwards and Haime, 45.  
*dichotoma*, Lamouroux, 41, 45, 173.  
*dichotoma* (Linneus), 40, 41, 280.  
*ecrinula* (Ehrenberg), 40, 41, 43, 280.  
*elongata*, Phillips, xlv.  
*erythræa*, Ehrenberg, 41, 292.  
*mediterranea*, Risso, xlv.  
*verticillata*, Lamouroux, 40, 43.  
 Mopseadæ, xli, 24, 25.  
 Mopseinæ, xlv, 25, 33.  
*Mopsella*, xxxvi, 171, 292.  
*coccinea* (Ellis), 172.  
*dichotoma*, Gray, 40, 173.  
*dichotoma*, Verrill, 41.  
*elongata*, Gray, 172.  
*elongata*, Verrill, 172.  
*erythræa* (Ehrenberg), 40.  
*retifera* (Lamarck), 172.  
 Mopselladæ, xxxv, 170.  
*Morchellana*, xxv, 191.  
*Muricea*, l, lvii, 93, 98, 118, 123, 133, 285.  
*bebrycoides*, Köl liker, 284.  
*bicolor*, n. sp., 134, 285.  
*flexuosa*, Köl liker, 124.  
*humosa*, Köl liker, 124.  
*nitida*, Köl liker, 124.  
*placomus*, Ehrenberg, 98.  
*tuberculata*, Köl liker, 124.  
*umbraticoides*, Studer, 124.  
*verticillaris*, Dana, 78.  
 Muriceadæ, liv, 92.  
 Muriceidæ, ix.  
*Muriceides*, lii, 93, 105, 283.  
*fragilis*, n. sp., 105, 283.  
*Muricella*, lvi, 93, 123, 284.  
*complanata*, n. sp., 125, 285.  
*crassa*, n. sp., 181, 285.  
*flexuosa*, Ridley, 285.  
*gracilis*, n. sp., 129, 285.  
*humosa* (Esper), 284.  
*nitida*, Verrill, 127, 285.  
*perramosa*, Ridley, 126, 285.  
*tenera*, Ridley, 124, 285.  
*tuberculata* (Esper), 284.  
*umbraticoides*, Studer, 124, 285.  
*Nannodendron*, xviii, xxi, 295.  
*Narella*, 56.  
*Nephtya*, xxiii, xxiv, xxv, 189, 191, 293.  
*coccinea*, Stimpson, 112.  
*nigra*, Pourtales, 190.  
*thyrsoides*, Verrill, 190.  
 Nephtyadæ, xxii.  
 Nephtyidæ, viii, xxii, 188.  
*Nicella*, lv, 154, 288.  
*mauritiana*, Gray, 288.  
*Nidalia*, xviii, xix, 241, 294.  
*atlantica*, Studer, xxi, 241.  
*occidentalis*, Gray, 294.  
 Nidalidæ, xviii.  
 Organidæ, xviii.  
*Organidus*, xviii, 296.  
*nordenskioldi*, Danielssen, 296.  
*Paragorgia*, xxxi, 291.  
*arborea* (Linneus), 290.  
*nodosa*, Koren and Danielssen, 291.  
 Paragorgiaceæ, xxxi.  
*Paralcyonium*, xviii, xix, 189, 295.  
*elegans*, Milne-Edwards, 295.  
*Paramuricea*, lii, 93, 98, 99, 282.  
*æquatorialis*, n. sp., 100, 283.  
*atlantica* (Yate Johnson), 99, 283.  
*borealis*, Verrill, 99.  
*elegans*, Grieg, 283.  
*gracilis*, Studer, 99, 110.  
*grandis*, Verrill, 283.  
*grayi* (Yate Johnson), 99, 283.  
*hirta* (Pourtales), 99, 283.  
*intermedia*, Köl liker, 99.  
*johnsoni*, Studer, 99, 283.  
*laxa*, n. sp., 101, 283.  
*placomus* (Ehrenberg), 99, 131, 283.  
*ramosa*, n. sp., 101, 283.

- Paramuricea spinosa*, K  liker, 99.  
*tenuis*, Verrill, 283.  
*Paranephthya*, xxiii, 189, 227, 294.  
*capitulifera*, n. sp., 227, 294.  
*Parisis*, xxxvi, xxxvii, 171, 181, 292.  
*australis*, n. sp., 183, 292.  
*fruticosa*, Verrill, 182, 292.  
*laxa*, Verrill, 184, 292.  
*mauritiensis*, Ridley, 182, 292.  
*minor*, n. sp., 184, 292.  
*Pavonaria*, xxviii.  
*scirpea*, Blainville, 154.  
*Pennatula*, xxvii.  
*mirabilis*, Linneus, 154.  
*Pennatulacea*, 187.  
*Pennatulida*, xxvii.  
*Perisceles*, lv.  
*Phenilia*, lxvii, 289.  
*sanguinolenta*, Gray, 289.  
*Phycogorgia*, lxiv, 288.  
*Phyllogorgia*, lxiii.  
*Placogorgia*, liv, 93, 113, 284.  
*atlantica*, n. sp., 113, 284.  
*Platycaulos*, lxi, 146, 286.  
*danielsseni*, n. sp., 147, 286.  
*Platyrgorgia*, lix.  
*Pleurocorallium*, xxxvii, 185, 293.  
*johnsoni*, Gray, 187, 293.  
*secundum*, Dana, 186, 293.  
*Plexaura*, lviii, 135, 137, 154.  
*antipathes* (Esper), 142.  
*arbuscula*, Phillipi, 152.  
*flexuosa*, Lamarck, 137.  
*friabilis*, Milne-Edwards, 143.  
*miniacea*, Ehrenberg, 152.  
*olivacea*, Lamouroux, 144.  
*porosa* (Esper), 142.  
*pr  longa*, Ridley, 138.  
*valenciennesi*, n. sp., 137.  
*Plexaurella*, lviii, 135, 140.  
*philippinensis*, n. sp., 140.  
*vermiculata* (Lamarck), 142.  
*Plexaurid  *, lvii, 135, 286.  
*Plexauroides*, lviii, 136, 138.  
*pr  longa* (Ridley), 138, 286.  
*Plumarella*, xlix, 53, 73, 76, 281.  
*delicatissima*, n. sp., 74, 281.  
*hilgendorfi*, Studer, 62.  
*penna* (Lamarck), 74, 281.  
*pourtalesi*, Verrill, 74, 281.  
*Policella*, xxix.  
*Primnoa*, xlviii, 282.  
*antarctica*, Valenciennes, 56, 59, 65.  
*australasia*, Gray, 80, 88.  
*compressa*, Verrill, 80.  
*flabellum*, Ehrenberg, 76, 79.  
*gracilis*, Milne-Edwards, 76.  
*imbricata*, Yate Johnson, 56.  
*plumatilis*, Milne-Edwards, 74, 76.  
*pourtalesi*, Verrill, 73.  
*regularis*, Duchassaing and Michelotti, 56.  
*reseda*, Linneus, 282.  
*trilepis*, Pourtales, 50.  
*verticellaris*, Ehrenberg, 80.  
*verticillaris*, Milne-Edwards, 78.  
*vetusta*, K  liker, 80.  
*Primnoace  *, xlv, 1, 46.  
*Primnoad  *, xlv, 46.  
*Primnoella*, xlix, 53, 80, 282.  
*australasia*, Gray, 88, 282.  
*biserialis*, n. sp., 87, 282.  
*distans*, Studer, 85, 282.  
*flagellum*, Studer, 85, 282.  
*grandisquamis*, n. sp., 86, 282.  
*magellanica*, Studer, 83, 282.  
*murrayi*, n. sp., 84, 282.  
*Primnoid  *, ix, xlv, 46.  
*Primnoides*, l, 90.  
*sertularoides*, n. sp., 90.  
*Primnoidin  *, 47, 90.  
*Primnoin  *, xlvii, 47, 52.  
*Primnoisis*, xlv, 25, 33, 34, 279.  
*ambigua*, n. sp., 39, 279.  
*antarctica* (Studer), 34, 279.  
*capensis* (Studer), 279.  
*rigida*, n. sp., 37, 279.  
*sparsa*, n. sp., 36, 279.  
*Protocaulon*, xxviii.  
*Protoptilum*, xxix.  
*Prymnoa*, xlviii.  
*Pseudogorgia*, lix, 136.  
*Pseudaxonia*, xxx.  
*Pseudogorgia*, xiii, xvi, xxvii, 253, 298.  
*godeffroyi*, K  liker, 298.  
*Pseudoplexaura*, lviii, 136, 141.  
*crassa* (Ellis and Solander), 142.  
*Psilacabaria*, xxxvi, 171, 292.  
*gracillima*, Ridley, 292.  
*Pteroeides*, xxvii.  
*Pterogorgia*, lxiii, 165.

- Ptilosarcus*, xxxiii.  
*Raynerella*, 154.  
*Rhipidella*, 165.  
     *verticillata*, Gray, 167.  
*Rhipidogorgia*, lxiii.  
     *verriculata*, Milne-Edwards, 167.  
*Rhizoxenia*, viii, ix, xi, xii, xiii, xvi, 253, 297.  
*Riisea*, xli, 24, 153.  
     *paniculata*, Duchassaing and Michelotti, 278.  
*Sarakka*, xviii, xix, 295.  
*Sarcodictyon*, vii, xii, xiii, 253, 297.  
     *catenata*, E. Forbes, 297.  
Sarcophytidæ, xviii.  
*Sarcophytum*, x, xviii, xx, 238, 242, 244, 295.  
     *ambiguum*, n. sp., 247.  
     *atlanticum*, n. sp., 245.  
     *glaucum*, Quoy and Gaimard, 246, 248.  
     *lobulosum*, Lesson, 248.  
     *philippinensis*, n. sp., 246.  
     *pulmo*, Ehrenberg, 249.  
     *purpureum*, Koren and Danielssen, xxi, 242.  
     *tongatabuensis*, n. sp., 245.  
     *trocheliophorum*, Marenzeller, 249.  
*Sciophyllum*, xxvii.  
*Scirpearella*, lxv, 154.  
     *gracilis*, n. sp., 156, 288.  
     *moniliforme*, n. sp., 156, 288.  
     *profunda*, n. sp., 155, 288.  
     *rubra*, n. sp., 157, 288.  
*Scirpearia*, lxv, 154, 288.  
     *dichotoma*, Gray, 288.  
     *funiculina*, Duchassaing and Michelotti, 154.  
     *mirabilis*, Cuvier, lxv, 154.  
*Scleranthelia*, xii, xv, xvi, 298.  
     *musica*, Studer, 298.  
*Scleraxonia*, ix, x, xxx, 162, 290.  
*Sclerisis*, xlv.  
     *pulchella*, Studer, 279.  
*Sclerobelemnon*, xxviii.  
*Sclerogorgia*, xxxiv, 165, 166.  
     *patula* (Ellis), 166.  
     *suberosa*, Kölliker, 167.  
     *suberosa* (Pallas), 166.  
Sclerogorgiaceæ, 161.  
Sclerogorgidæ, xxxiv, 165, 291.  
*Scleronephthya*, xxiii, xxvi, 189, 229, 294.  
     *pustulosa*, n. sp., 229, 294.  
*Scleroptilum*, xxix.  
*Scytalium*, xxviii.  
*Semperina*, xxxii, 290.  
*Semperina rubra*, Kölliker, 290.  
*Siphonogorgia*, xxiii, xxvi, 189, 235, 236, 294.  
     *godeffroyi*, Kölliker, 236, 294.  
     *köllikeri*, n. sp., 236, 276, 294.  
     *mirabilis*, Klunzinger, 236, 294.  
     *mirabilis*, Klunzinger, var. Ridley, 294.  
     *squarrosa*, Kölliker, 236, 294.  
Siphonogorgiaceæ, xxii, xxvi, 188.  
Siphonogorginæ, xxvi, 189, 226.  
*Solanderia*, xxxiv.  
*Solenocaulon*, viii, xxxi, 162, 290.  
     *grayi*, Studer, 162, 290.  
     *tortuosum*, Gray, 162, 290.  
     *tubulosum* (Genth), 162, 290.  
*Solenogorgia*, xxxi.  
*Spoggodes*, xxv, 191.  
*Spoggodia*, xxv, 191.  
Spoggodidæ, xxii, 188.  
Spoggodinæ, xxii, 189.  
*Spongioderma*, xxx, xxxi, 291.  
     *verrucosa* (Möbius), 291.  
Spongioderminæ, xxxiii, 162, 164.  
*Spongodes*, ix, xxv, 189, 191, 294.  
     *anguina*, n. sp., 205, 225.  
     *arborescens*, Dana, 192, 200, 225.  
     *bicolor*, n. sp., 207, 226.  
     *capitata*, Verrill, 225.  
     *carnea*, n. sp., 196, 225.  
     *celosia*, Lesson, 192, 200, 225.  
     *cervicornis*, n. sp., 220, 226.  
     *coccinea*, Studer, 223, 225.  
     *collaris*, n. sp., 208, 226.  
     *coronata*, n. sp., 212, 226.  
     *corymbosa*, n. sp., 201, 225.  
     *digitata*, n. sp., 193, 225.  
     *divaricata*, Gray, 226.  
     *dendrophyta*, n. sp., 204, 225.  
     *flabellum*, Studer, 224, 226.  
     *florida* (Esper), 192, 200, 225.  
     *gigantea*, Verrill, 192, 225.  
     *glomerata*, Studer, 222, 225.  
     *gracilis*, Verrill, 226.  
     *hemprichi*, Klunzinger, 225.  
     *heterocyathus*, n. sp., 210, 226.  
     *klunzingeri*, Studer, 224, 226.  
     *laxa*, n. sp., 217, 226.  
     *macrospina*, n. sp., 199, 225.  
     *monticularis*, n. sp., 215, 226.  
     *nephthyæformis*, n. sp., 195, 225.  
     *pumilio*, Studer, 223, 225.

- Spongodes punicea*, Studer, 222, 225.  
*pustulosa*, n. sp., 213, 226.  
*ramulosa*, Gray, 226.  
*ramulosa*, Klunzinger, 224.  
*rhodosticta*, n. sp., 218, 226.  
*rigida*, Studer, 223, 225.  
*savignyi* (Ehrenberg), 192, 195, 225.  
*semperi*, Studer, 221, 225.  
*spicata*, n. sp., 194, 225.  
*spinosa*, Gray, 197, 225.  
*spinosa*, Studer, 197.  
*spinulosa*, Gray, 226.  
*studerii*, Ridley, 197, 225.  
*umbellata*, n. sp., 203, 225.  
*unicolor*, Gray, 226.
- Stachyodes*, xlviii, 53, 280.  
*regularis*, n. sp., 55, 280.
- Stachyptilum*, xxviii.
- Stenella*, xlviii, 53, 56, 280.  
*acanthina*, n. sp., 59, 281.  
*doederleini*, n. sp., 58, 281.  
*gigantea*, n. sp., 57, 281.  
*imbricata*, Yate Johnson, 281.  
*johnsoni*, n. sp., 57, 281.  
*spinosa*, n. sp., 58, 281.
- Stenogorgia*, lxii, 287.  
*casta*, Verrill, 148, 287.  
*rosea*, Grieg, 287.
- Strophogorgia*, viii, 2, 6, 277.  
*challengeri*, Perceval Wright, 3, 277.  
*fragilis*, n. sp., 2, 277.  
*petersi*, n. sp., 2, 277.  
*verrilli*, Perceval Wright, 3, 277.
- Strophogorginae*, xl.
- Stylatula*, xxviii.
- Styloblemnon*, xxix.
- Suava*, xxviii.
- Suberia*, xxxii, 162, 290.  
*clavaria*, Studer, 162, 290.  
*genthi*, n. sp., 163, 290.  
*köllikeri*, Studer, 162, 290.
- Suberogorgia*, xxxv, 165, 291.  
*köllikeri*, n. sp., 167, 291.  
*suberosa* (Pallas), 166, 291.  
*verriculata* (Esper), 167, 291.
- Swiftia*, lxii, 288.  
*exserta*, Duchassaing and Michelotti, 146, 288.
- Sympodiadæ*, 270.
- Sympodium*, vii, xii, xv, xvi, 270, 298.  
*abyssorum*, Danielssen, 271, 298.
- (ZOOLOG. CHALL. EXP.—PART LXIV.—1889.)
- Sympodium armatum*, n. sp., 272, 298.  
*cæruleum*, Ehrenberg, 271, 298.  
*coralloides*, Pallas, 271, 298.  
*fuliginosum*, Ehrenberg, 271, 298.  
*fulvum*, Forskal, 271, 298.  
*glomeratum*, n. sp., 273, 298.  
*norvegicum*, Koren and Danielssen, 271, 298.  
*purpurascens*, Ehrenberg, 271, 298.  
*verrilli*, n. sp., 271, 298.
- Syringoporidæ*, vi.
- Telescella*, xiv.
- Telesco*, xiv, 259, 260.  
*smithii*, Gray, 259.
- Telestinae*, 252.
- Telesto*, viii, ix, xii, xvi, 253, 259, 297.  
*arborea*, n. sp., 262, 297.  
*aurantiaca*, Lamouroux, 259, 261, 297.  
*fruticulosa*, Dana, 259, 262, 297.  
*lutea*, Lamouroux, 259.  
*nodosa*, Verrill, 259.  
*pelasgica*, Lamouroux, 259.  
*prolifera*, v. Koch, 262, 297.  
*ramulosa*, Verrill, 259, 261, 297.  
*rigida*, n. sp., 261.  
*riisei*, Duchassaing and Michelotti, 262, 297.  
*rupicola*, Fritz Müller, 262, 297.  
*smithi*, Gray, 259, 262, 297.  
*trichostemma* (Dana), 262, 297.
- Thesca*, li, lvi, 284.  
*exserta* (Ellis and Solander), 146.  
*gemmata*, Verrill, 147, 284.  
*guadalupeensis*, Duchassaing and Michelotti, 146, 284.
- Thouarella*, xlix, 53, 56, 59, 281.  
*affinis*, n. sp., 67, 281.  
*antarctica* (Valenciennes), 60, 65, 281.  
*hilgendorfi* (Studer), 62, 281.  
*köllikeri*, n. sp., 64, 281.  
*moseleyi*, n. sp., 61, 281.  
*variabilis*, n. sp., 68.  
*variabilis*, var. *brevispinosa*, nov., 69.  
*variabilis*, var. *gracilis*, nov., 70.
- Titanideum*, xxxiii, 164, 291.  
*suberosum* (Ellis and Solander), 291.
- Trichoptilum*, xxix.
- Trinella*, xxxvii, 181.  
*swinhoei*, Gray, 182.
- Trinelladæ*, xxxv, 170.
- Trinellidæ*, 170.
- Tubipora*, ix, xii, xvii, 296.

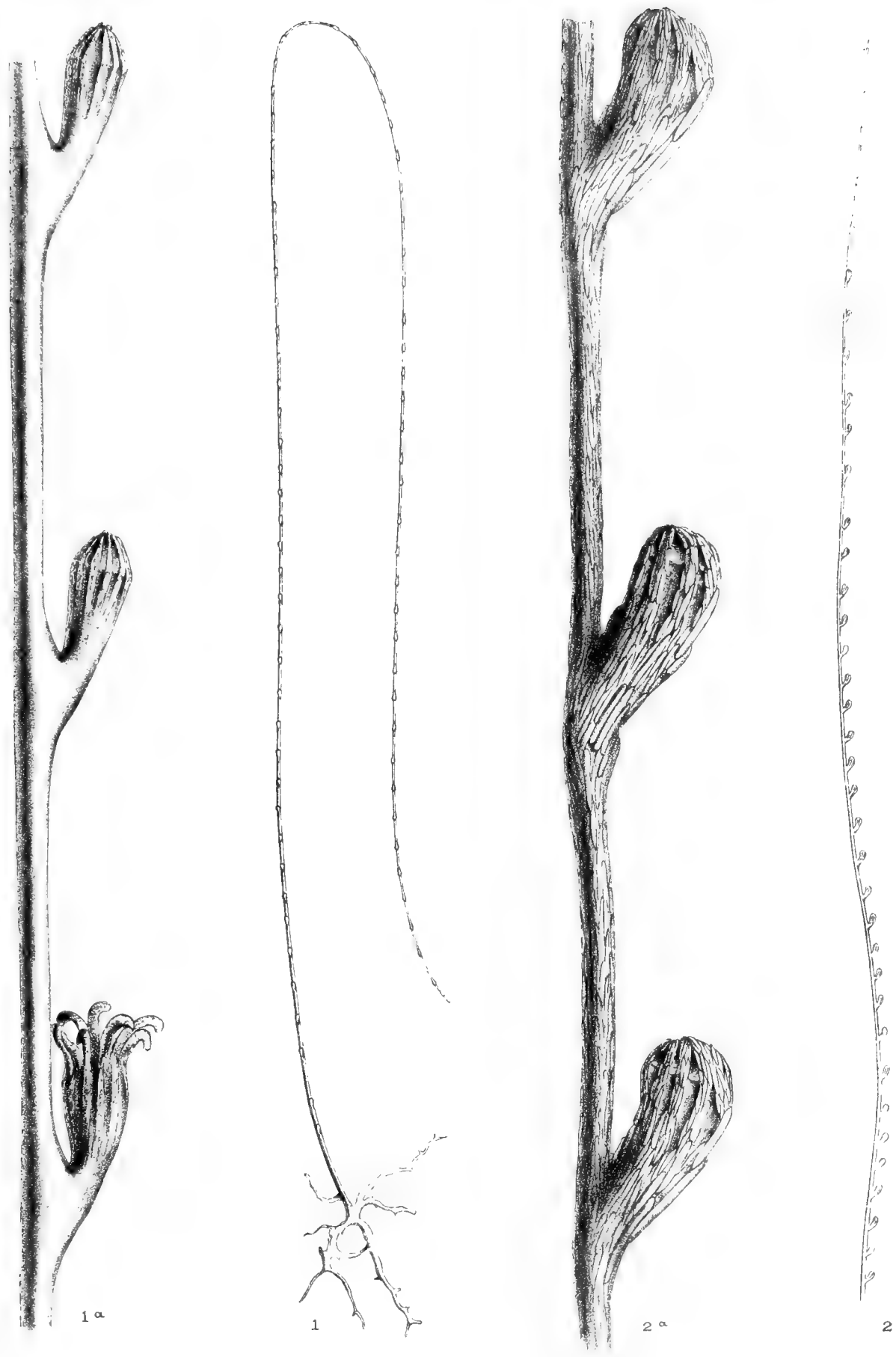
- Tubipora musica*, Linneus, 252.  
 Tubiporida, xvi.  
 Tubiporidæ, vi, xvi, 252, 296.  
 Tubiporina, xvi, 252.  
*Umbellula*, xxviii.  
 Umbellulidæ, xxviii.  
*Veretillum*, xxix.  
*Verrucella*, lxvi, 1, 24, 289.  
     *candida*, Ridley, 289.  
     *gemmacea* (Valenciennes), 158.  
     *granifera*, Kölliker, 289.  
     *guadalupensis*, Duchassaing and Michelotti, 289.  
     *ramosa*, Kölliker, 289.  
*Villogorgia*, lii, liii, 93, 98, 99, 109, 110, 283.  
     *flabellata* (Gray), 111.  
     *gracilis*, Studer, 111, 283.  
     *intricata* (Gray), 111, 283.  
     *mauritiensis*, Ridley, 99, 109, 111, 283.  
     *nigrescens*, Duchassaing and Michelotti, 98, 109, 111, 283.  
*Viminella*, 154.  
*Viminella flagellum*, Gray, lxv.  
*Virgularia*, xxviii.  
 Virgularidæ, xxviii.  
*Væringia*, xxiii, 189, 293.  
*Wardella*, xviii.  
*Wrightella*, xxxvi, 292.  
     *chrysanthus*, Gray, 292.  
     *coccinea*, Gray, 292.  
*Xenia*, xvi, xvii, 252, 296.  
     *carybæorum*, Duchassaing and Michelotti, 298.  
     *elongata*, Dana, 252.  
     *fuscescens*, Ehrenberg, xvii.  
     *indivisa*, Sars, xviii.  
     *umbellata*, Ehrenberg, xvii.  
 Xeniadæ, xvii.  
 Xenidæ, xvii.  
 Xeniidæ, xi, xvii, 252.  
*Xiphigorgia*, lxviii, 288.  
*Xiphocella*, 76, 79.  
     *esperi*, Gray, 79.

## PLATE I.

# PLATE I.

Fig. 1	<i>Strophogorgia challenger</i> , Per. Wright ; natural size,	Page 3
Fig. 1a.	„ „ three polyps ; enlarged.	
Fig. 2.	„ <i>verrilli</i> , Per. Wright ; natural size,	3
Fig. 2a.	„ „ three polyps ; enlarged	

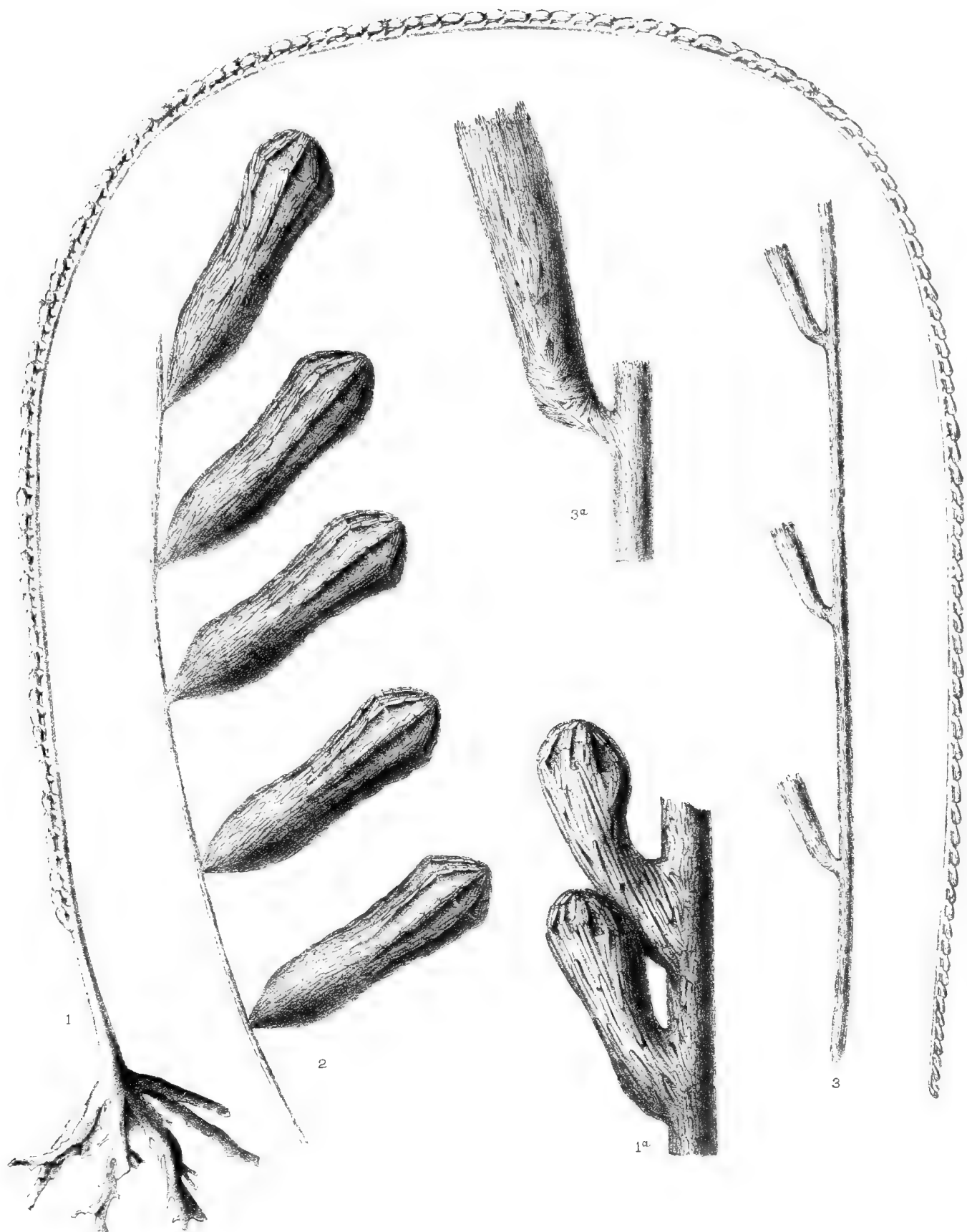




STROPHOGORGIA

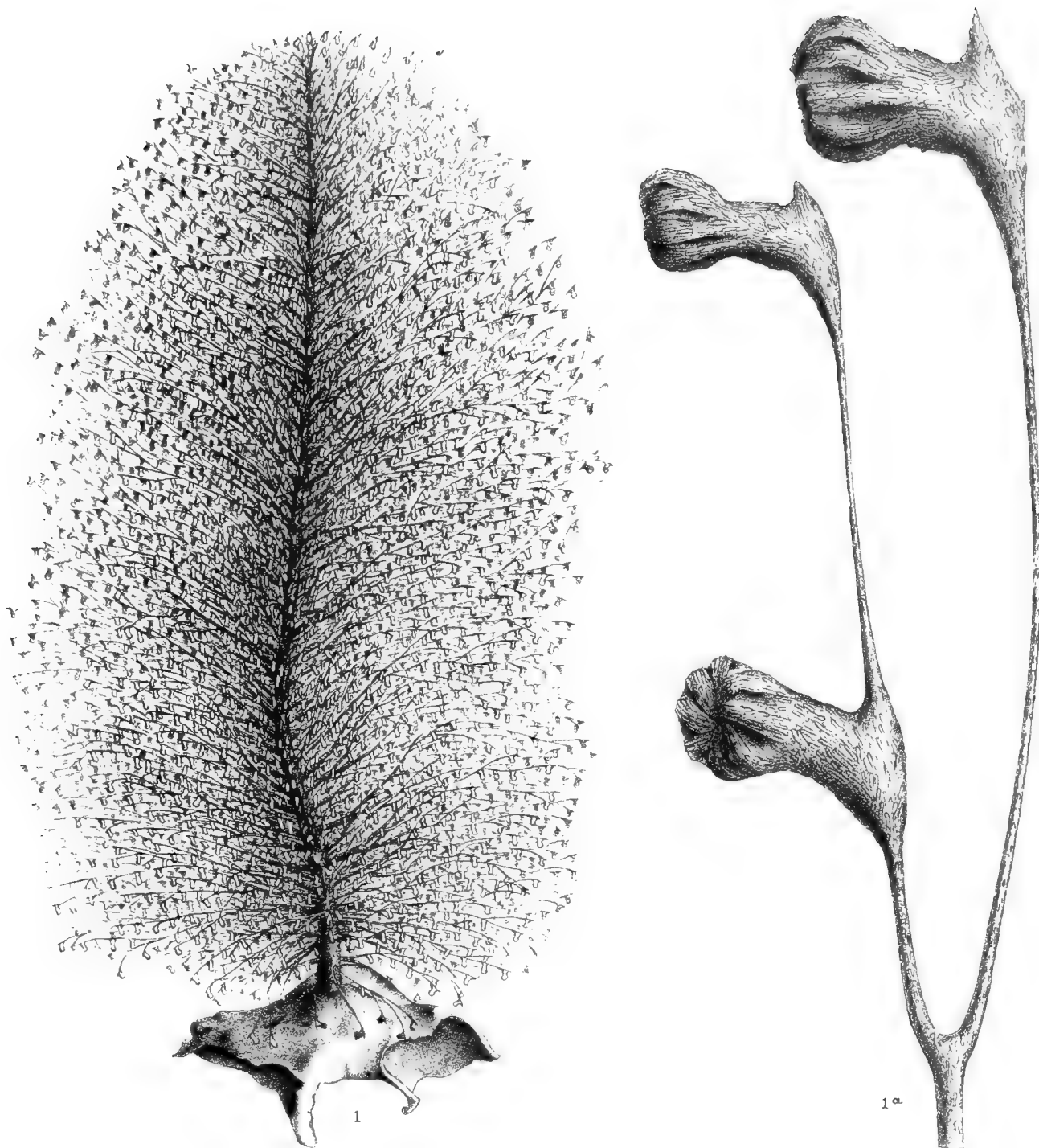
## PLATE II.

- |   | Page |
|---|------|
| Fig. 1. <i>Strophogorgia petersi</i> , n. sp.; natural size,  | 2    |
| Fig. 1a. „ „ two polyps; enlarged.  |      |
| Fig. 2. „ <i>fragilis</i> , n. sp.; five polyps; enlarged,  | 4    |
| <p>Figs. 3, 3a. <i>Trichoptilum</i>, Kölliker. Through an inadvertence these figures have been engraved on this Plate, they represent a possibly new species of this genus. The very imperfect specimen was taken at a depth of 1900 fathoms at Station 143, off the Cape of Good Hope.</p> |      |



# PLATE III.

	Page
Fig. 1. <i>Dasygorgia cupressa</i> , n. sp. Natural size, . . . . .	11
Fig. 1a. „ „ two twigs, with three polyps, showing the characteristic stem endings ; enlarged.	

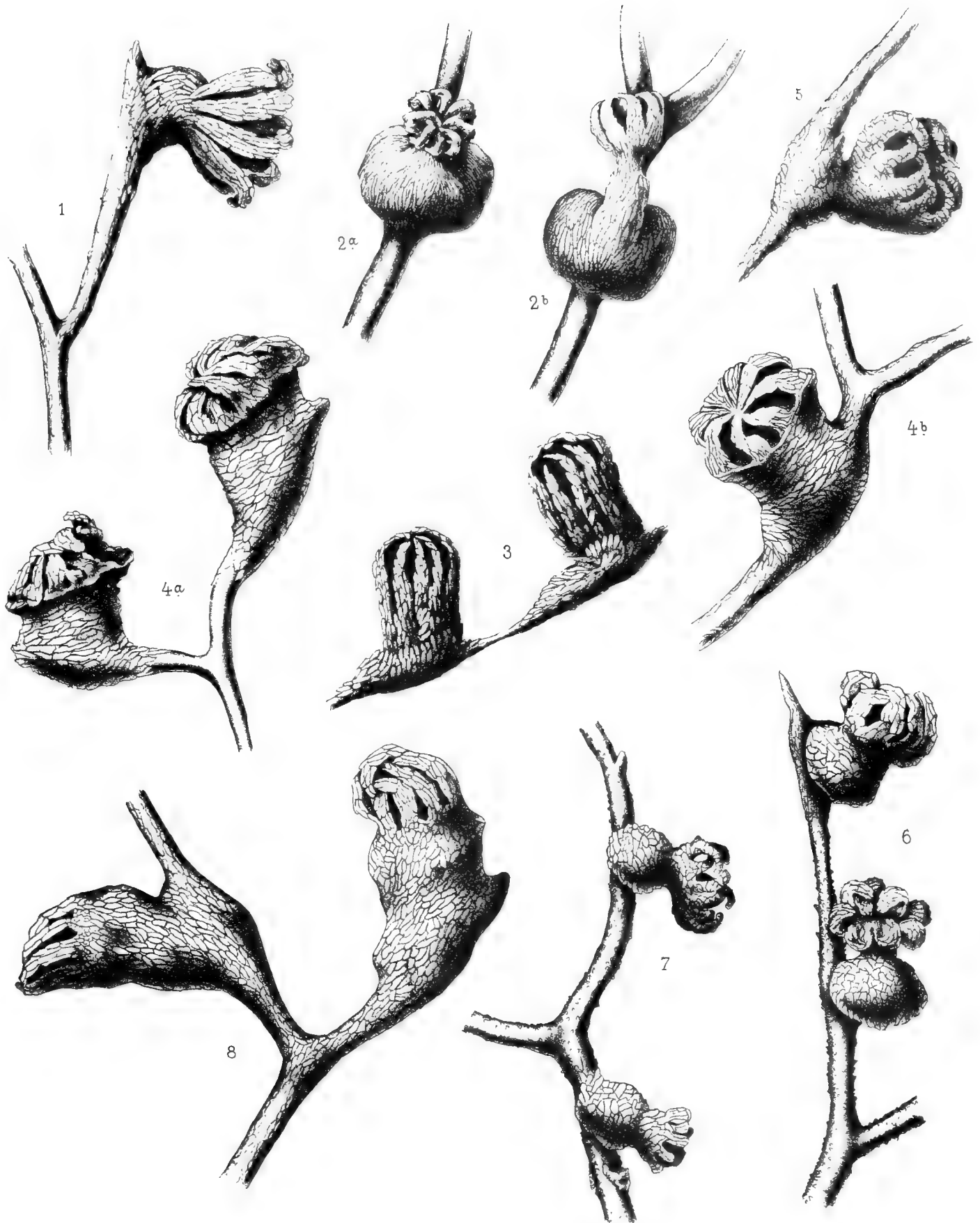


DASYGORGIA.

# PLATE IV.

		Page
Fig. 1.	<i>Dasygorgia spiculosa</i> , Verrill. Terminal polyp, . . . . .	9
Fig. 2.	„ <i>flexilis</i> , n. sp. <i>a</i> , Polyp retracted; <i>b</i> , polyp partly expanded, showing the distended body-cavity, which is packed with ova, . . . . .	10
Fig. 3.	„ <i>melanotrichos</i> , n. sp. Two polyps, . . . . .	15
Fig. 4.	„ <i>expansa</i> , n. sp. <i>a</i> , Two terminal polyps; <i>b</i> , polyp from the central portion of the colony, . . . . .	16
Fig. 5.	„ <i>geniculata</i> , n. sp. One of the lateral polyps, . . . . .	17
Fig. 6.	„ <i>acanthella</i> , n. sp. Two polyps, one terminal. The openings of the siphonozoids are scattered through the cœenchyma, . . . . .	18
Fig. 7.	„ <i>axillaris</i> , n. sp. Two lateral polyps. Also with siphonozoids, . . . . .	20
Fig. 8.	„ <i>japonica</i> , n. sp. A terminal and a lateral polyp, . . . . .	21

All these figures are enlarged.



# PLATE V.

	Page
Fig. 1. Spicules of <i>Dasygorgia spiculosa</i> , Verrill,	9
Fig. 2. „ „ <i>flexilis</i> , n. sp.,	10
Fig. 3. „ „ <i>cupressa</i> , n. sp.,	11
Fig. 4. „ „ <i>squarrosa</i> , n. sp.,	14
Fig. 5. „ „ <i>melanotrichos</i> , n. sp.,	15
Fig. 6. „ „ <i>expansa</i> , n. sp.,	16
Fig. 7. „ „ <i>geniculata</i> , n. sp.,	17
Fig. 8. „ „ <i>acanthella</i> , n. sp.,	18
Fig. 9. „ „ <i>axillaris</i> , n. sp.,	20
Fig. 10. „ „ <i>japonica</i> , n. sp.,	21





F. Ammonites Bern. del. lit. et. imp.

# PLATE V A.

	Page
Fig. 1. Spicules of <i>Strophogorgia petersii</i> , n. sp.,	2
Fig. 2. „ „ „ <i>challengeri</i> , Per. Wright,	3
Fig. 3. „ „ „ <i>verrilli</i> , Per. Wright,	3
Fig. 4. „ „ „ <i>fragilis</i> , n. sp.,	4
Fig. 5. <i>Ceratoisis philippinensis</i> , n. sp.,	27
Fig. 6. „ „ <i>grandiflora</i> , Studer,	27
Fig. 7. „ „ <i>paucispinosa</i> , n. sp.,	28
Fig. 8. „ „ <i>nuda</i> , n. sp.,	28
Fig. 9. Spicules of <i>Bathygorgia profunda</i> , Per. Wright,	32
Fig. 10. Transverse section through a polyp of <i>Dasygorgia flexilis</i> . n. sp.,	10
Fig. 11. Siphonozoids of <i>Dasygorgia axillaris</i> , n. sp.,	20

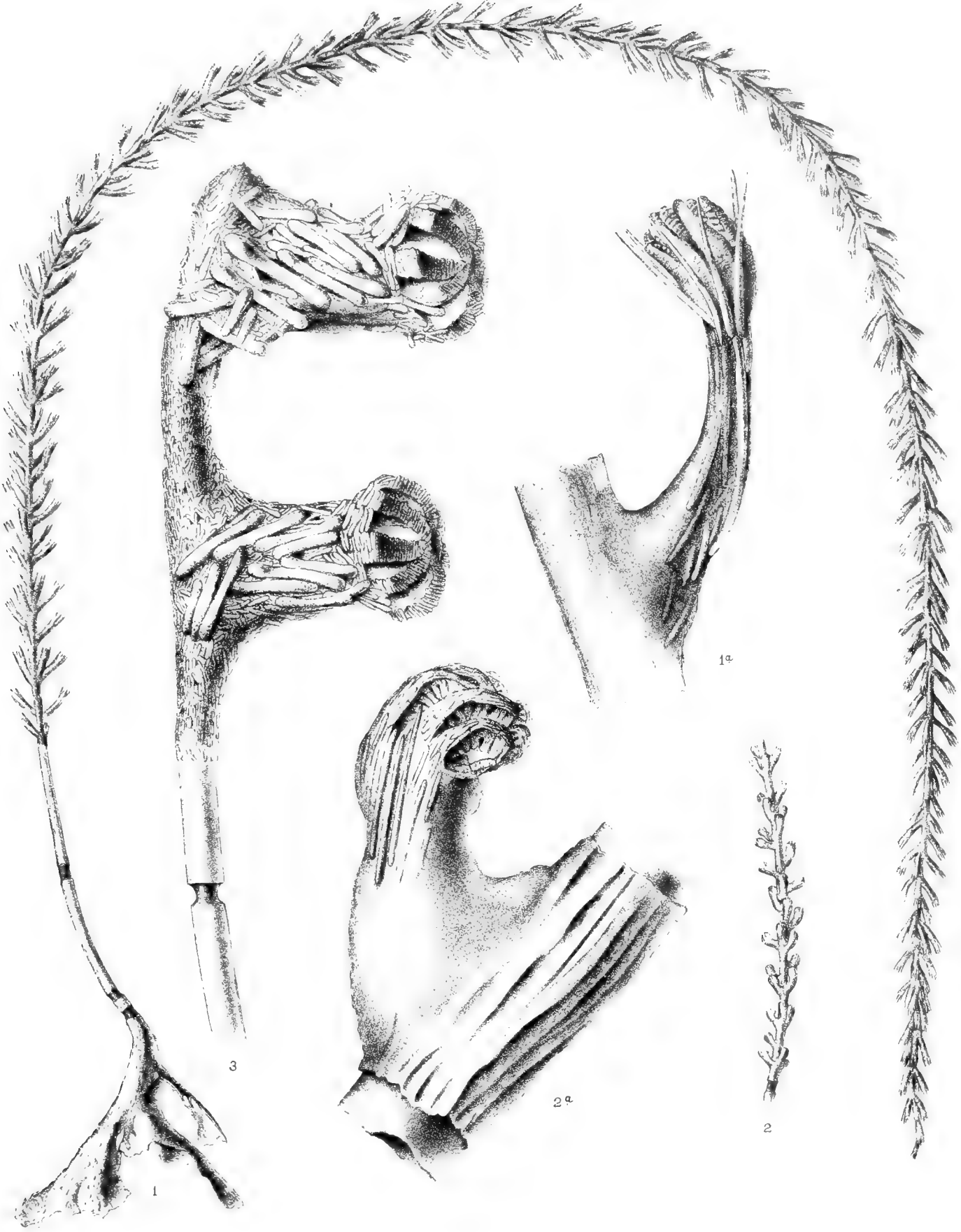


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STROPHOGORGIA. CERATOISIS. BATHYGORGIA. DASYGORGIA.

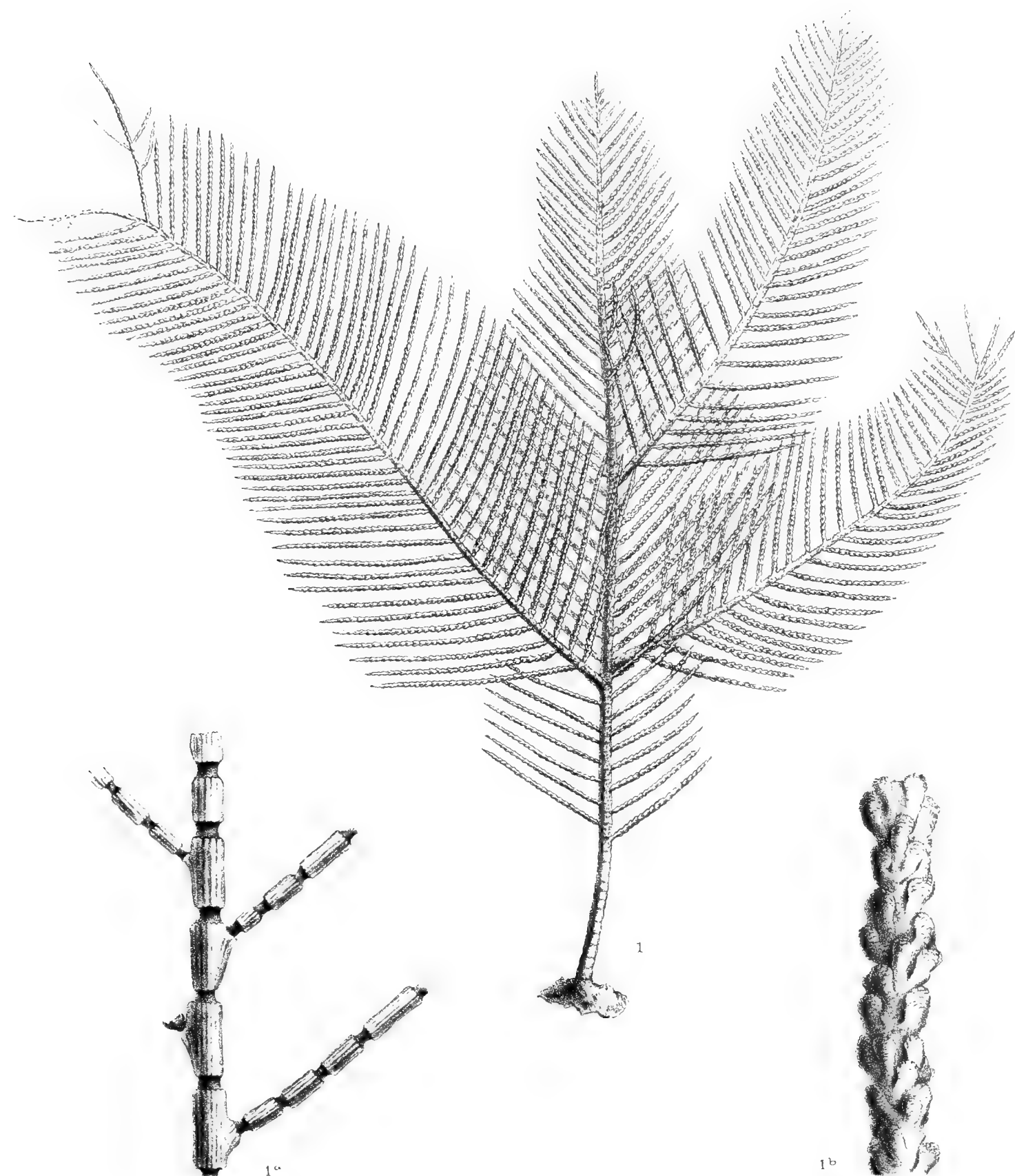
# PLATE VI.

Fig. 1.	<i>Ceratoisis paucispinosa</i> , n. sp.	Natural size,	.	.	.	.	Page 28
Fig. 1a.	„	„	Polyp enlarged.				
Fig. 2.	„	<i>nuda</i> , n. sp.	Fragment ; natural size,	.	.	.	28
Fig. 2a.	„	„	Polyp ; greatly enlarged.				
Fig. 3.	<i>Bathygorgia profunda</i> , Perceval Wright.	Two polyps ; enlarged,	.	.	.	.	32



# PLATE VII.

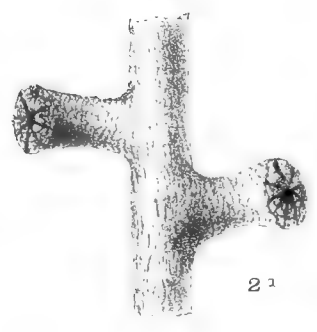
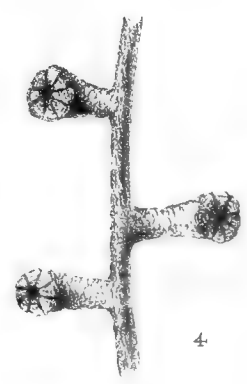
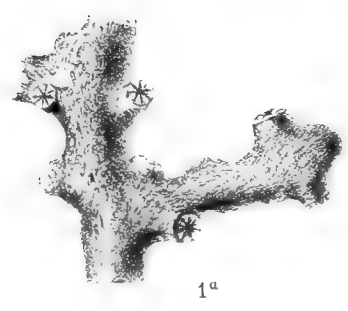
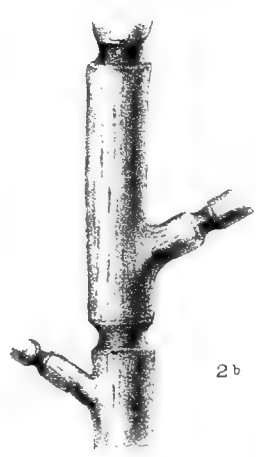
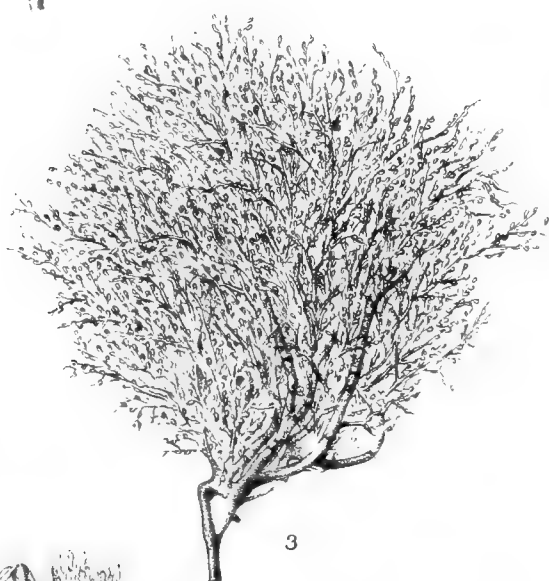
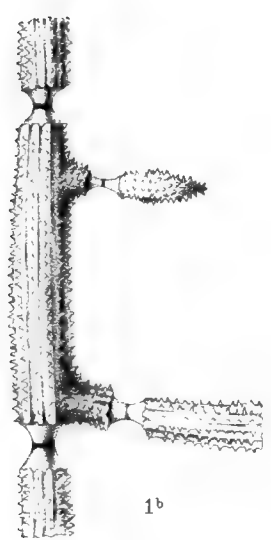
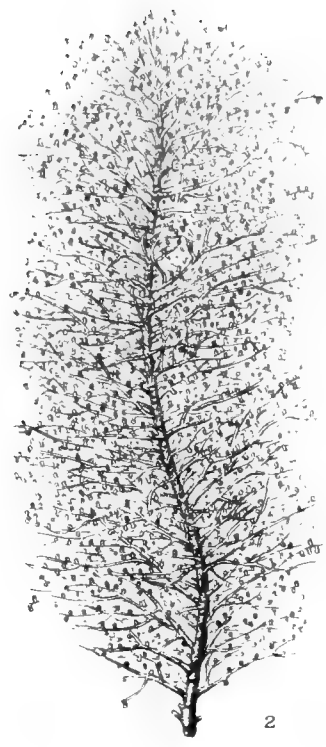
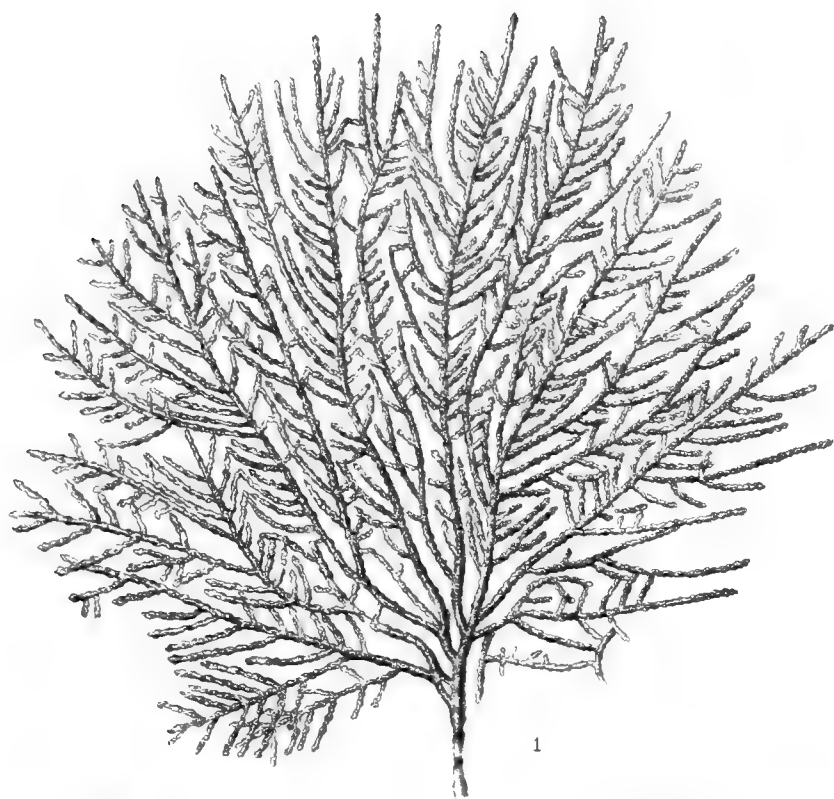
	Page
Fig. 1. <i>Mopsea encrinula</i> (Lamarek), . . . . .	43
Fig. 1 <i>a</i> . „ „ Portion of the axis showing the origin of the branches.	
Fig. 1 <i>b</i> . „ „ Polyps ; magnified.	



# PLATE VIII.

	Page
Fig. 1. <i>Acanthoisis flabellum</i> , n. sp. Natural size, . . . . .	45
Fig. 1a. „ „ Showing polyps ; magnified.	
Fig. 1b. „ „ Axis, showing the origin of the branches.	
Fig. 2. <i>Primnoisis antarctica</i> (Studer). Natural size, . . . . .	35
Fig. 2a. „ „ Polyps ; magnified.	
Fig. 2b. „ „ Axis, with origin of branches.	
Fig. 3. „ <i>rigida</i> , n. sp. Natural size, . . . . .	37
Fig. 3a. „ „ Polyps ; magnified.	
Fig. 4. „ <i>sparsa</i> , n. sp.; magnified, . . . . .	36





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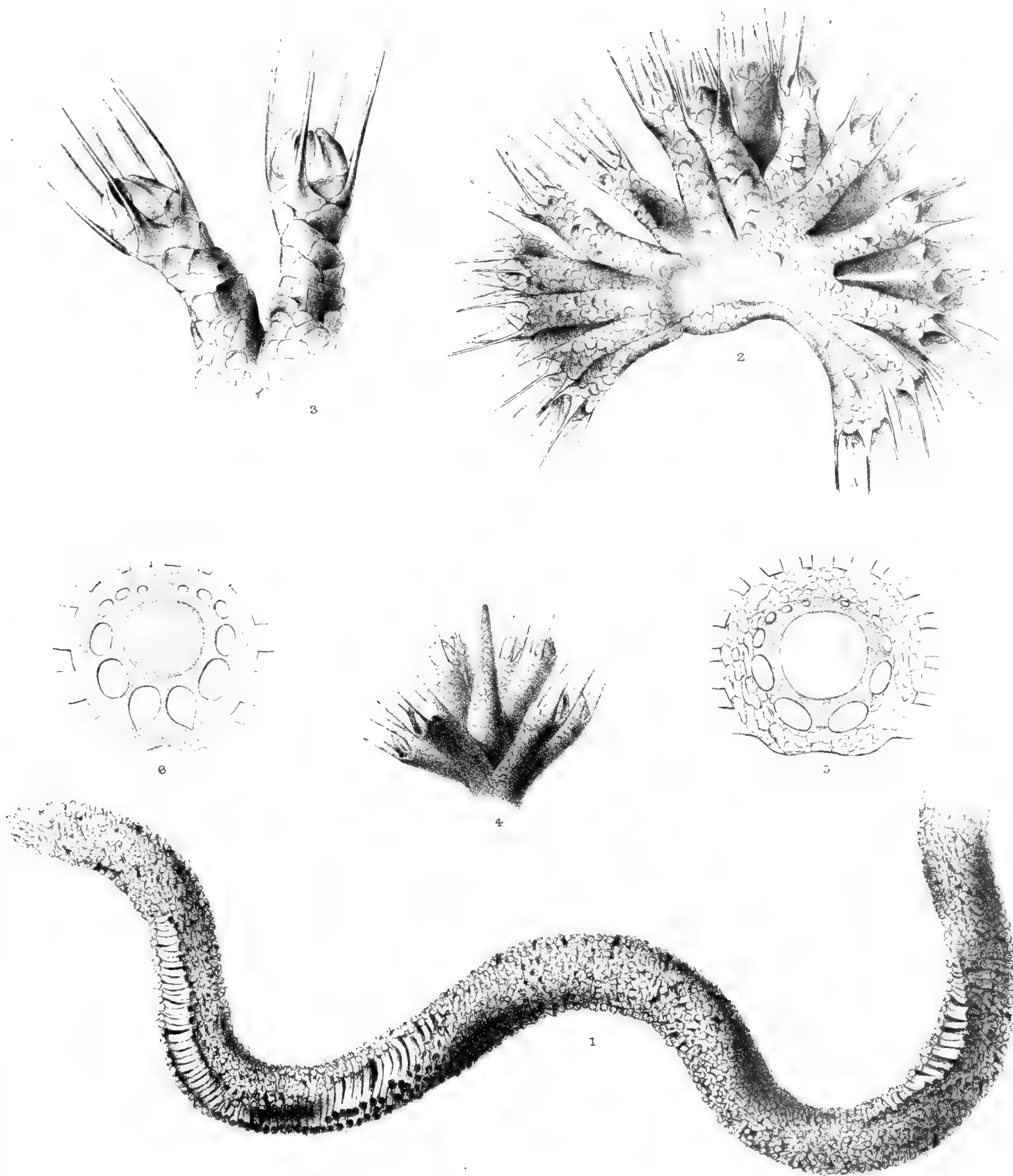
# PLATE IX.

Fig. 1.	Spicules of <i>Acanella arbuscula</i> (Johnson),	.	.	.	.	Page 30
Fig. 2.	„ „ <i>eburnea</i> (Pourtalès),	.	.	.	.	30
Fig. 3.	„ „ <i>chiliensis</i> , n. sp.,	.	.	.	.	31
Fig. 4.	„ „ <i>rigida</i> , n. sp.,	.	.	.	.	31
Fig. 5.	„ „ <i>simplex</i> , Verrill,	.	.	.	.	32
Fig. 6.	„ <i>Primnoisis antarctica</i> (Studer),	.	.	.	.	35
Fig. 7.	„ „ <i>sparsa</i> , n. sp.,	.	.	.	.	36
Fig. 8.	„ „ <i>rigida</i> , n. sp.,	.	.	.	.	37
Fig. 9.	„ „ <i>ambigua</i> , n. sp.,	.	.	.	.	39
Fig. 10.	„ <i>Mopsea dichotoma</i> (Linn.),	.	.	.	.	41
Fig. 11.	„ „ <i>encrinula</i> (Lamarek),	.	.	.	.	43
Fig. 12.	„ <i>Acanthoisis flabellum</i> , n. sp.,	.	.	.	.	45



# PLATE X.

			Page
Fig. 1.	<i>Callozostron mirabilis</i> , Perceval Wright.	Colony; natural size, . . .	48
Fig. 2.	„ „	Section through colony, showing the arrangement of the polyps on the flexible axis; enlarged.	
Fig. 3.	„ „	Two polyps, greatly magnified, showing scales.	
Fig. 4.	„ „	Terminal portion of main axis; enlarged.	
Fig. 5.	„ „	Section of main axis, decalcified.	
Fig. 6.	„ „	Section through axis, showing symmetrical arrangement of canals.	

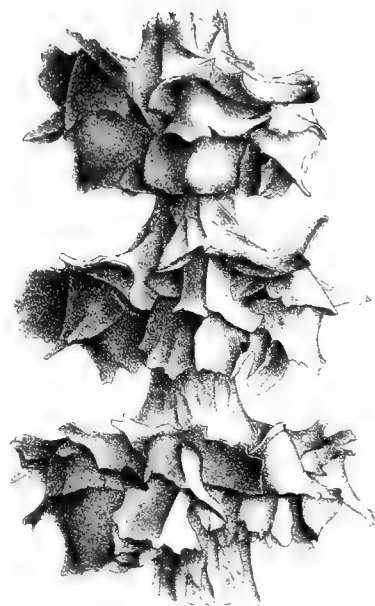


# PLATE XI.

Fig. 1.	<i>Calypterinus allmani</i> , n. sp.	Natural size,							Page
									53
Fig. 1a.	„	„	Polyps; enlarged ; lateral view (also <i>vide</i> Pl. XIV.						
			fig. 5).						
Fig. 2.	<i>Stachyodes regularis</i> , n. sp.	Natural size,							55
Fig. 2a.	„	„	Polyps ; enlarged ; lateral view.						



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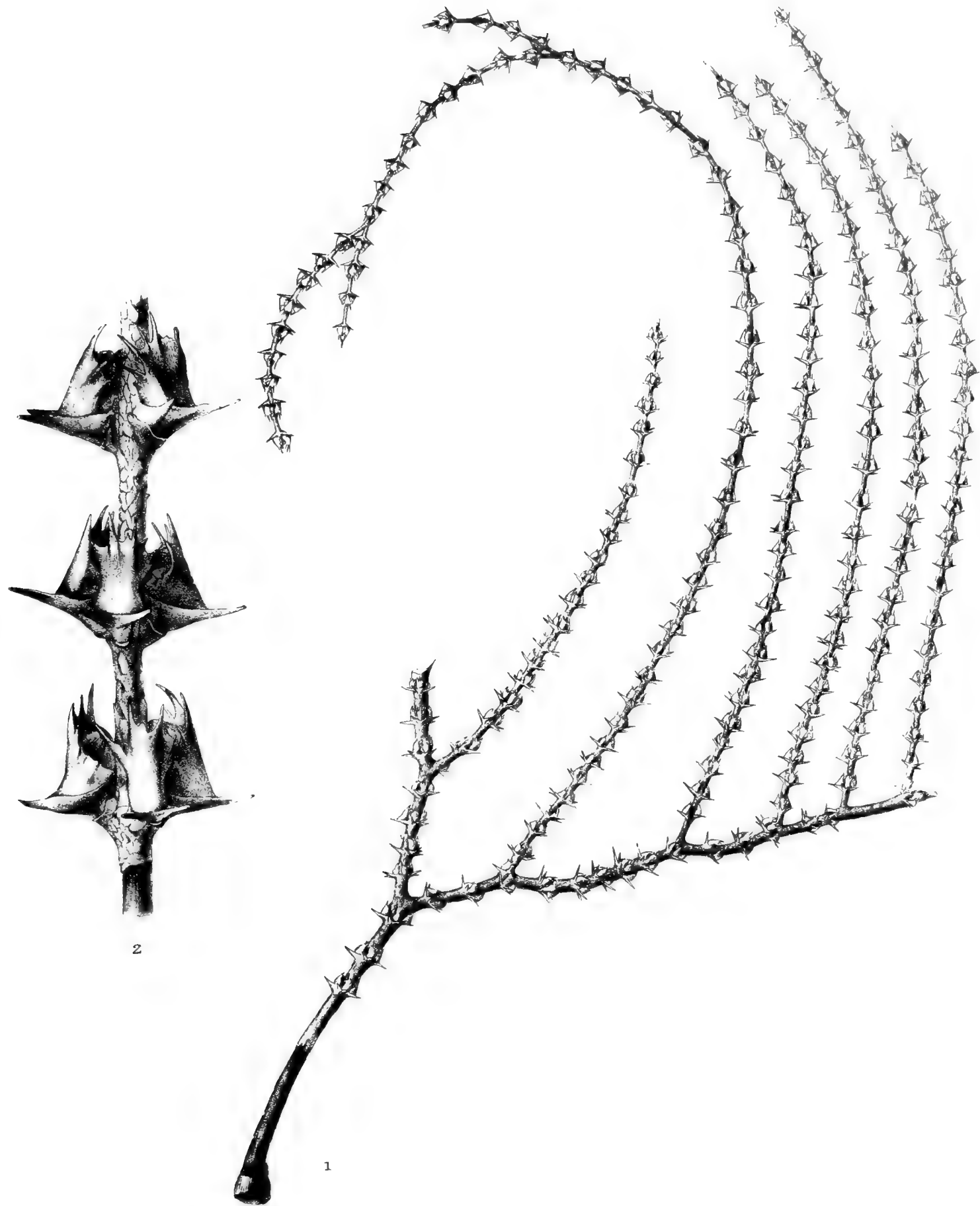


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PLATE XII.

- |         |                                       |                                       |   |      |
|---------|---------------------------------------|---------------------------------------|---|------|
| Fig. 1. | <i>Calyptrophora japonica</i> , Gray. | Part of a colony of the natural size, | . | Page |
| Fig. 2. | „                                     | „                                     |   | 50   |
|         |                                       | Polyps ; enlarged.                    |   |      |



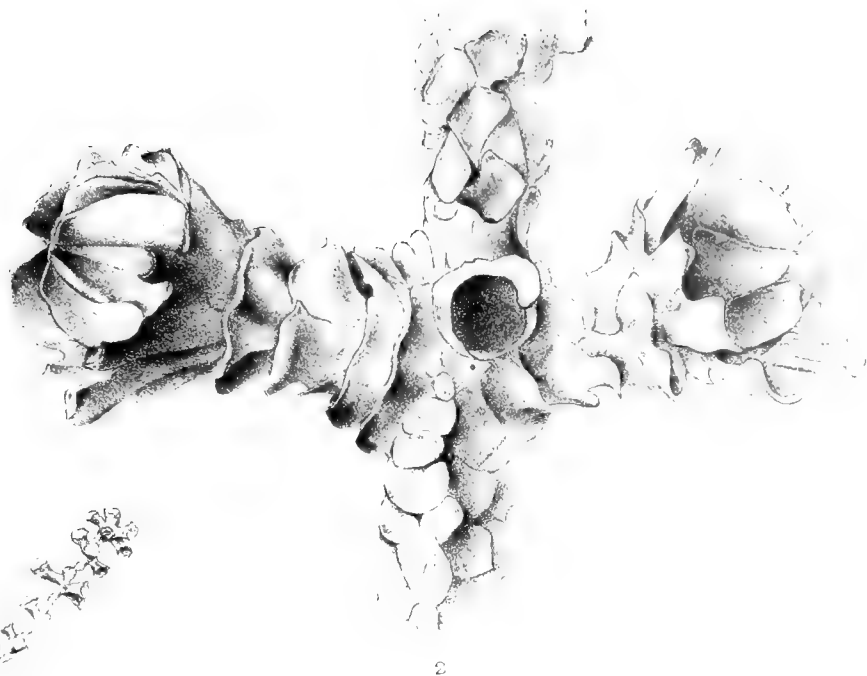
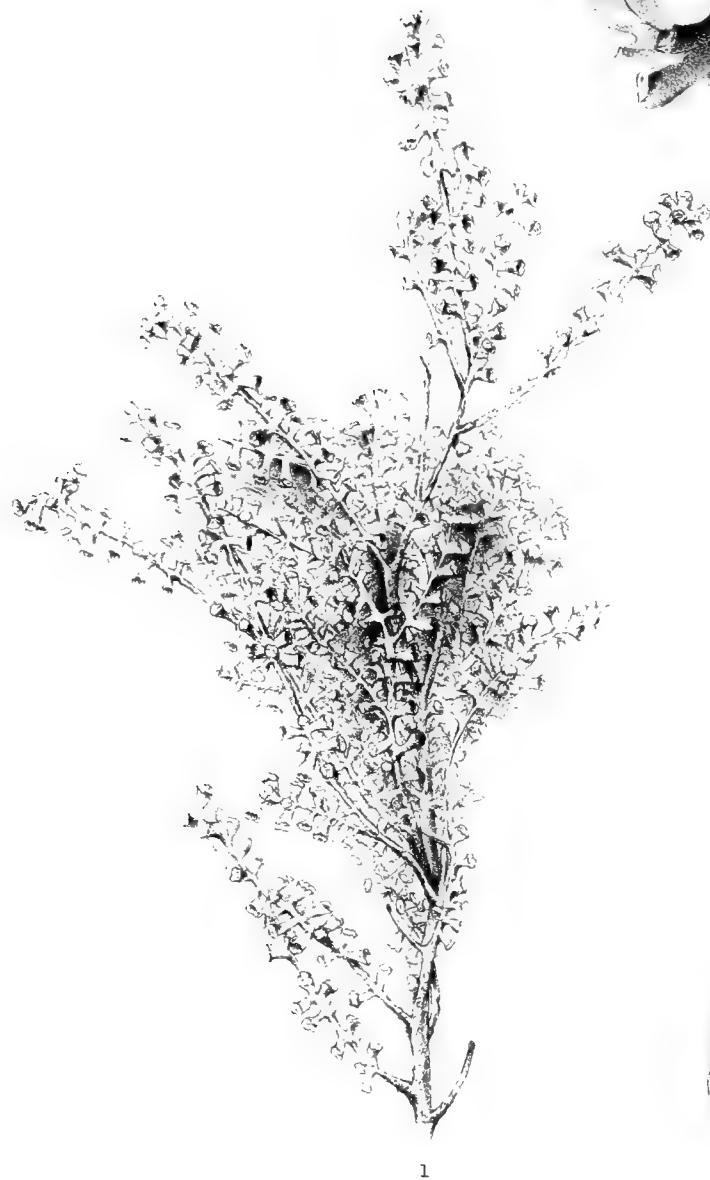


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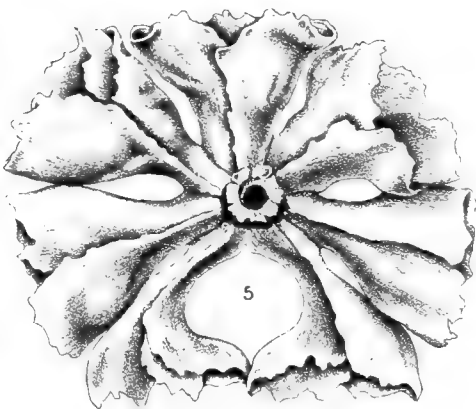
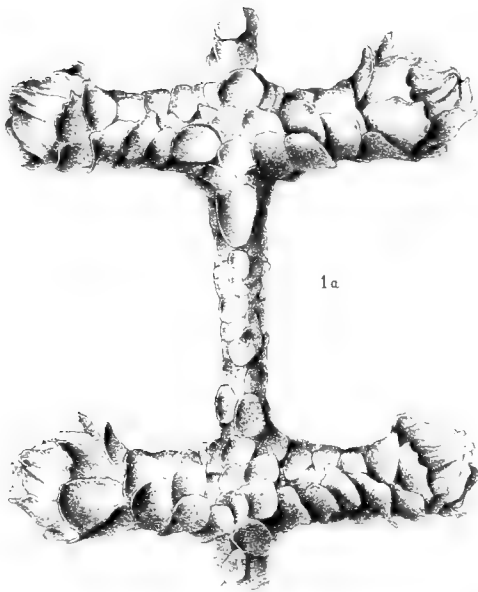
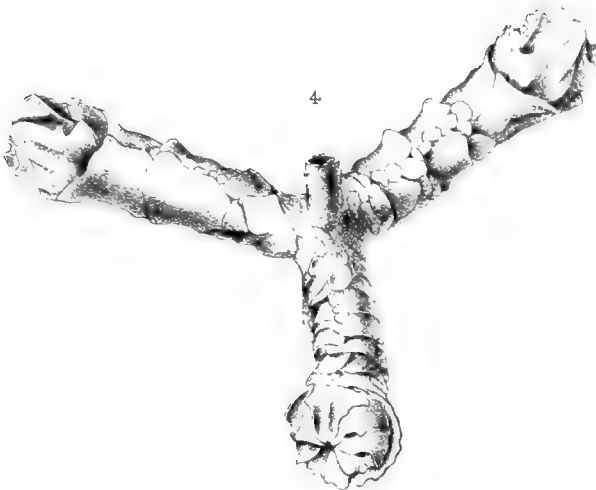
# PLATE XIII.

	Page
Fig. 1. <i>Stenella spinosa</i> , n. sp. Natural size. (After this specimen was drawn, several much larger and more characteristic specimens were discovered), . . . . .	58
Fig. 2. „ „ Two polyps ; enlarged.	
Fig. 3. „ <i>johnsoni</i> , n. sp. Two polyps ; enlarged, . . . . .	57



# PLATE XIV.

	Page
Fig. 1. <i>Thouarella moseleyi</i> , n. sp. Natural size, . . . . .	61
Fig. 1a. „ „ Polyps; enlarged.	
Fig. 2. <i>Caligorgia flabellum</i> (Ehrenberg). Lower portion of main axis, .	79
Fig. 2a. „ <i>sertosa</i> , n. sp. Polyps; enlarged, . . . . .	77
Fig. 3. <i>Stenella acanthina</i> , n. sp. Polyps; enlarged, . . . . .	59
Fig. 4. „ <i>gigantea</i> , n. sp. Polyps; enlarged, . . . . .	57
Fig. 5. <i>Calypterinus allmani</i> , n. sp. Whorl of polyps; enlarged, seen from above, . . . . .	53



STENELLA. THOUARELLA.  
CALIGORGIA CALYPTERINUS.

# PLATE XV.

Fig. 1.	<i>Amphilaphis regularis</i> , n. sp.	Colony ; natural size,				Page
Fig. 1a.	„	„	Polyps ; enlarged.			71

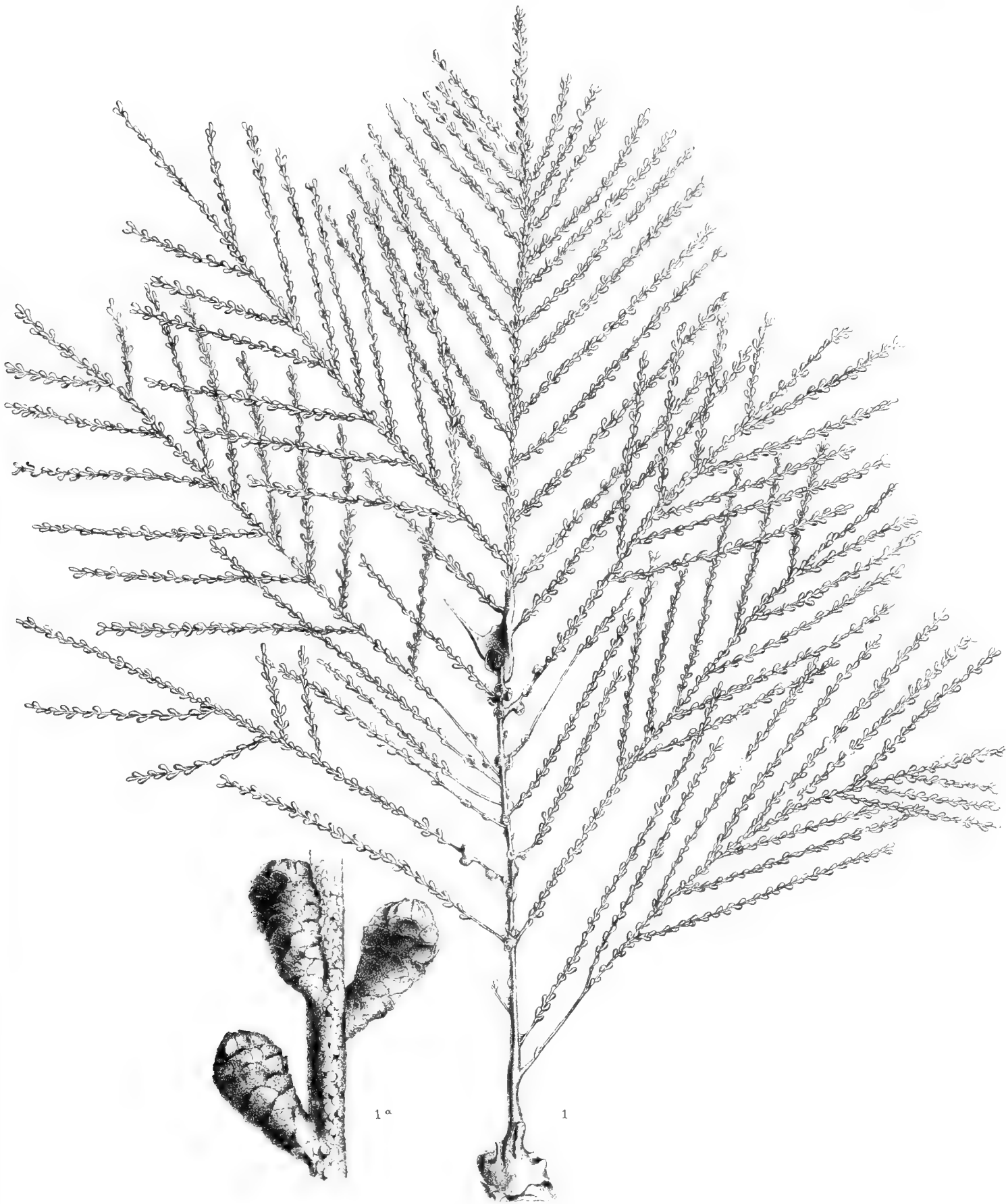
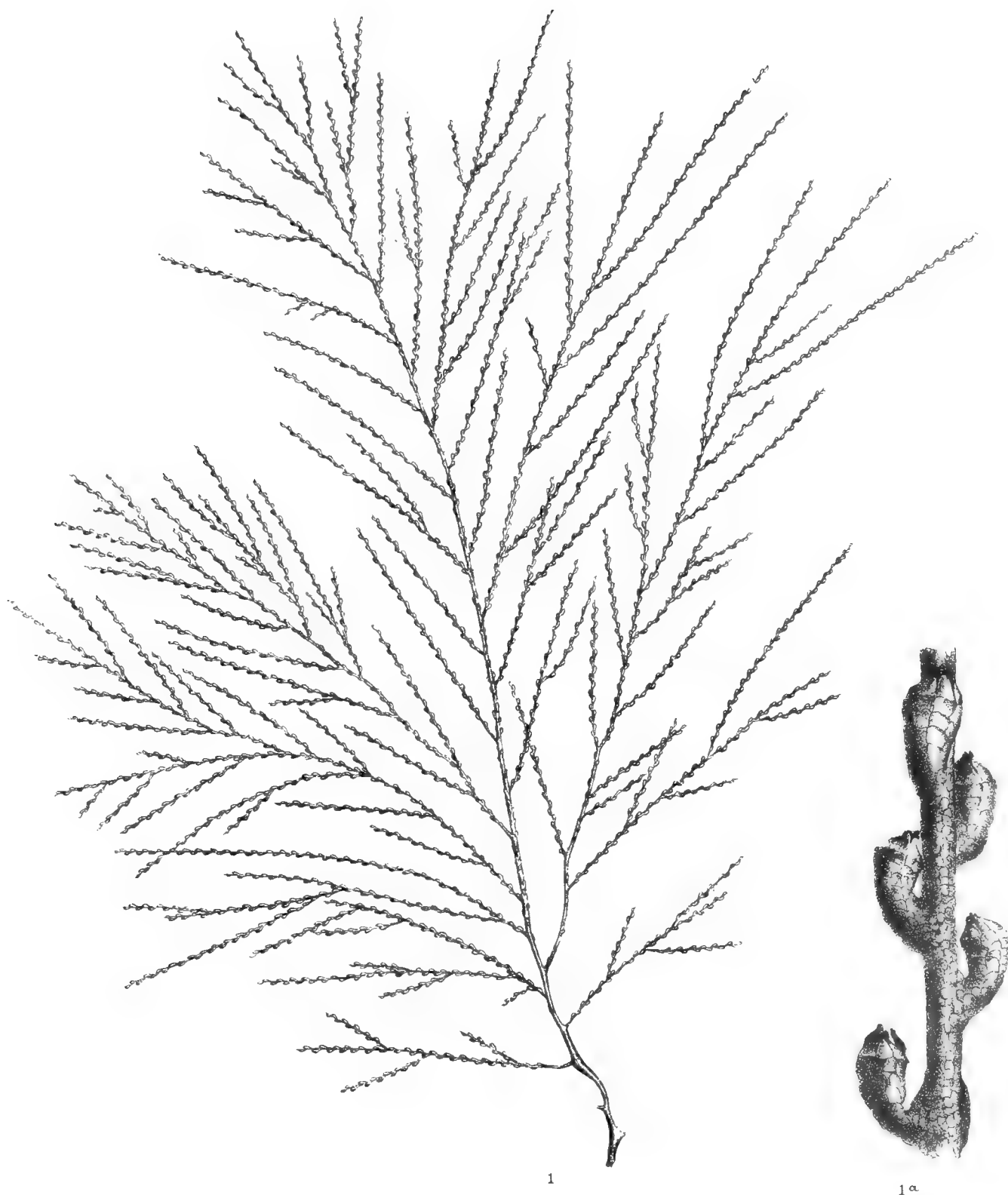


PLATE XVI.

			Page
Fig. 1.	<i>Plumarella delicatissima</i> , n. sp.	Part of a colony ; natural size,	74
Fig. 1a.	„ „	Polyyps ; enlarged.	

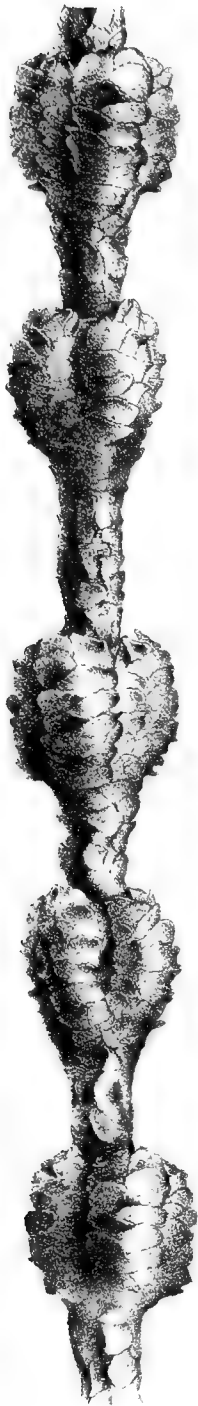




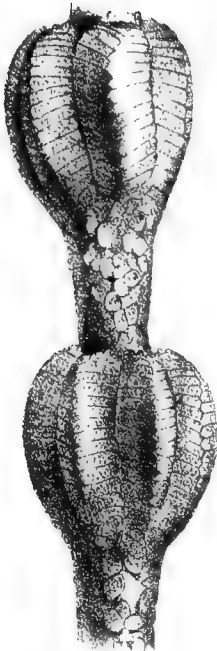
PLUMARELLA.

# PLATE XVII.

				Page
Fig. 1.	<i>Primnoella distans</i> , Studer.	Natural size,	.	85
Fig. 1a.	„	Polyps ; enlarged.		
Fig. 2.	„	<i>magellanica</i> , Studer. Polyps ; enlarged,	.	83
Fig. 3.	„	<i>biserialis</i> , n. sp. Polyps ; enlarged,	.	87
Fig. 4.	„	<i>grandisquamis</i> , n. sp. Polyps ; enlarged,	.	86



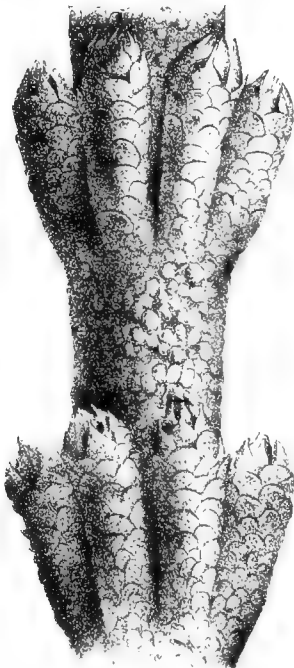
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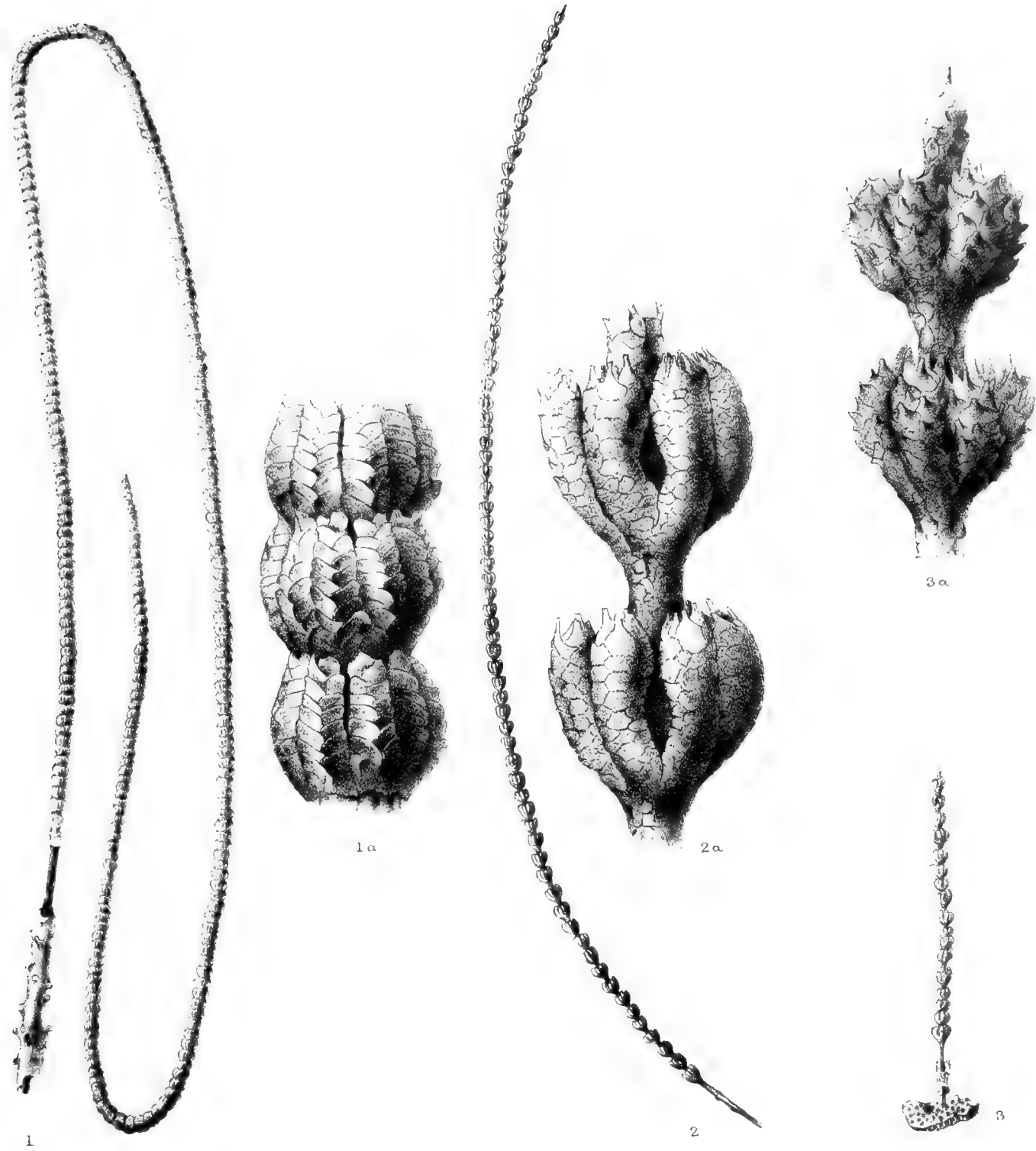
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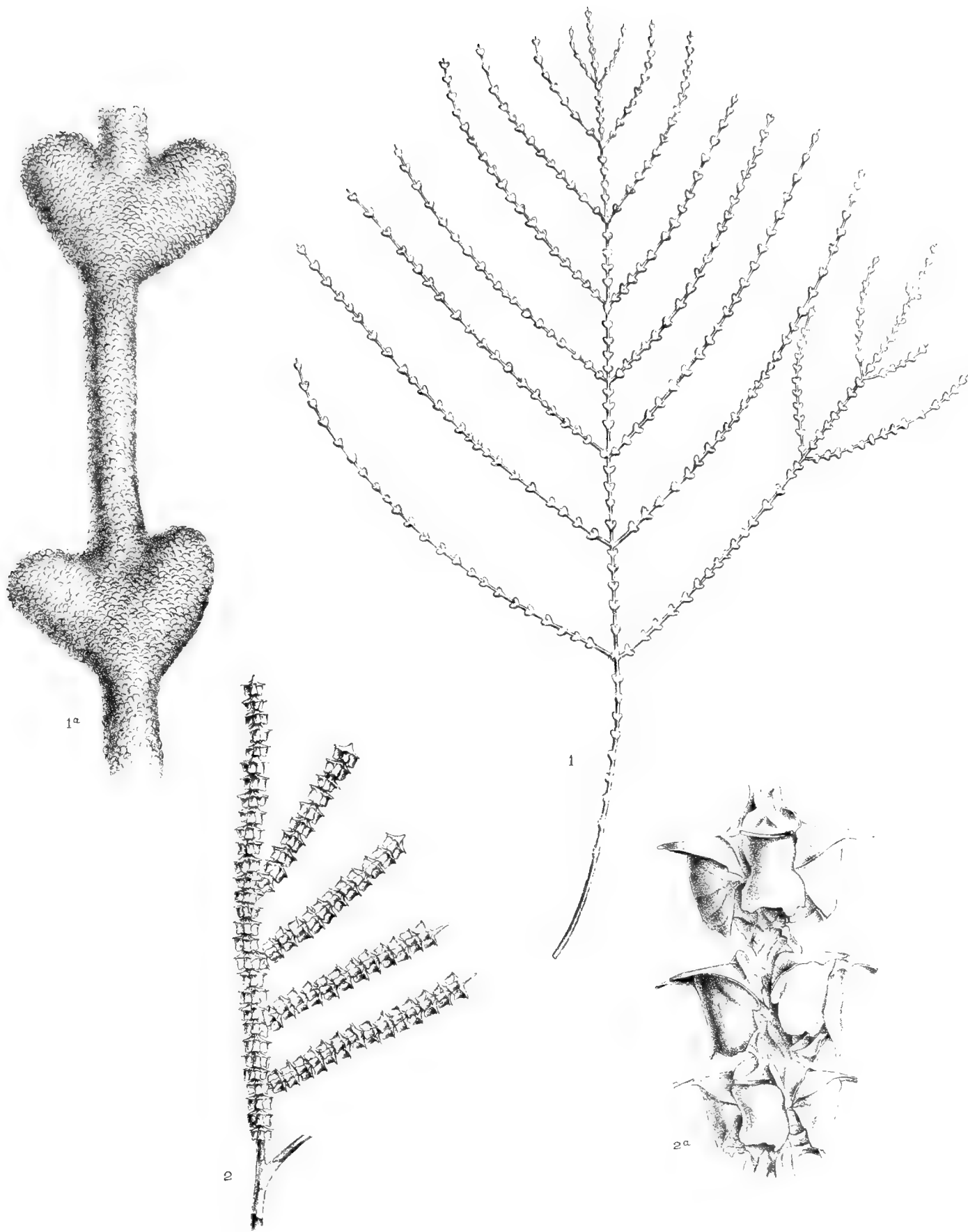
# PLATE XVIII.

		Page
Fig. 1.	<i>Primnoella australasiæ</i> , Gray. Natural size,	88
Fig. 1a.	„ „ Three whorls of polyps ; enlarged.	
Fig. 2.	„ <i>flagellum</i> , Studer. Natural size,	85
Fig. 2a.	„ „ Two whorls of polyps ; enlarged.	
Fig. 3.	„ <i>murrayi</i> , n. sp. Natural size,	84
Fig. 3a.	„ „ Two whorls of polyps ; enlarged.	



# PLATE XIX.

	Page
Fig. 1. <i>Primnoides sertularoides</i> , n. sp. Natural size, . . . . .	90
Fig. 1 <i>a</i> . „ „ Polyps ; enlarged.	
Fig. 2. <i>Calyptrophora wyvillei</i> , Perceval Wright. Natural size, . . . . .	52
Fig. 2 <i>a</i> . „ „ Three whorls of polyps ; enlarged.	

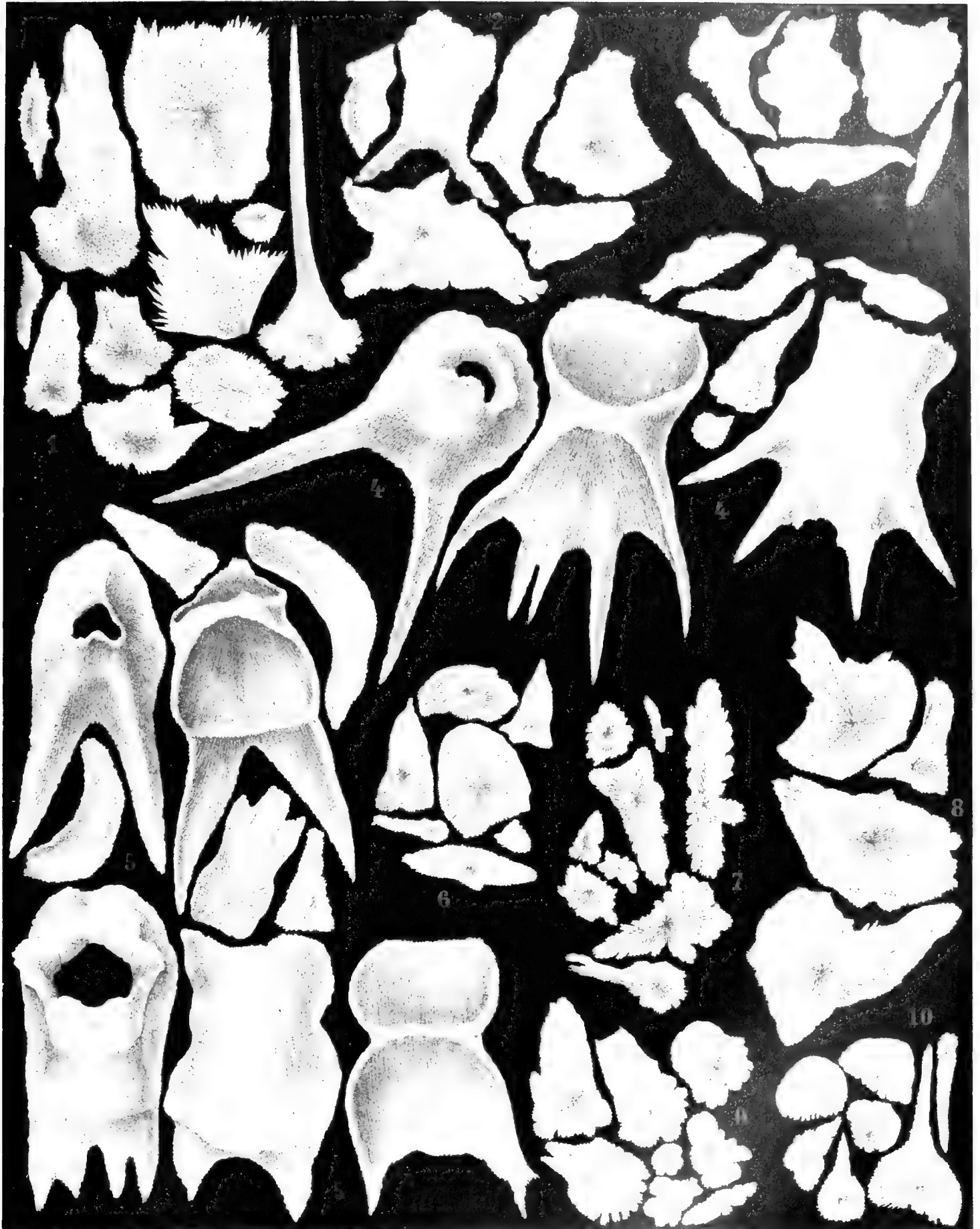


PRIMNOIDES, CALYPTROPHORA.

# PLATE XX.

	Page
Fig. 1. Spicules of <i>Callozostron mirabilis</i> , Perceval Wright, . . . . .	48
Fig. 2. „ <i>Calypterinus allmani</i> , n. sp., . . . . .	53
Fig. 3. „ <i>Stachyodes regularis</i> , n. sp., . . . . .	55
Fig. 4. „ <i>Calyptraphora japonica</i> , Gray, . . . . .	50
Fig. 5. „ „ <i>wyvillei</i> , Perceval Wright, . . . . .	52
Fig. 6. „ <i>Stenella johnsoni</i> , n. sp., . . . . .	57
Fig. 7. „ „ <i>dæderleini</i> , n. sp., . . . . .	58
Fig. 8. „ „ <i>gigantea</i> , n. sp., . . . . .	57
Fig. 9. „ „ <i>spinosa</i> , n. sp., . . . . .	58
Fig. 10. „ „ <i>acanthina</i> , n. sp., . . . . .	59



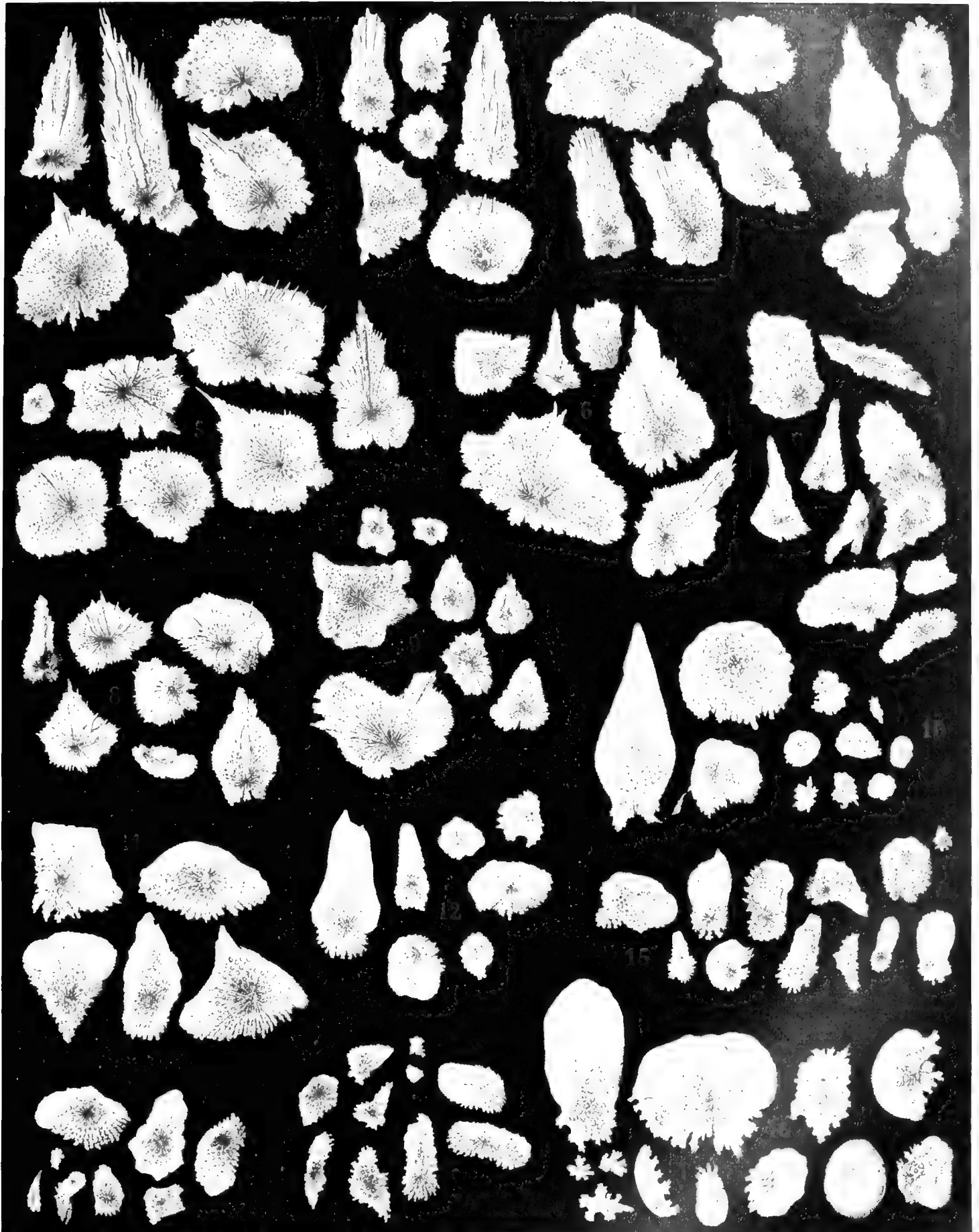


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CALLOZOSTROM CALYPTERINUS. STACHYODES CALYPTROPHORA. STENELLA.

# PLATE XXI.

	Page
Fig. 1. Spicules of <i>Thouarella variabilis</i> , n. sp., . . . . .	68
Fig. 2. „ „ „ <i>moseleyi</i> , n. sp., . . . . .	61
Fig. 3. „ „ „ <i>affinis</i> , n. sp., . . . . .	66
Fig. 4. „ „ „ <i>hilgendorfi</i> (Studer), . . . . .	62
Fig. 5. „ „ „ <i>köllikeri</i> , n. sp., . . . . .	64
Fig. 6. „ „ „ <i>antarctica</i> (Valenciennes), . . . . .	65
Fig. 7. „ „ <i>Amphilaphis regularis</i> , n. sp., . . . . .	71
Fig. 8. „ „ <i>Plumarella delicatissima</i> , n. sp., . . . . .	74
Fig. 9. „ „ <i>Caligorgia sertosa</i> , n. sp., . . . . .	77
Fig. 10. „ „ <i>Primnoella magellanica</i> , Studer, . . . . .	83
Fig. 11. „ „ „ <i>murrayi</i> , n. sp., . . . . .	84
Fig. 12. „ „ „ <i>flagellum</i> , Studer, . . . . .	85
Fig. 13. „ „ „ <i>grandisquamis</i> , n. sp., . . . . .	86
Fig. 14. „ „ „ <i>biserialis</i> , n. sp., . . . . .	87
Fig. 15. „ „ „ <i>australasiæ</i> , Gray, . . . . .	88
Fig. 16. „ „ <i>Primnoides sertularoides</i> , n. sp., . . . . .	90

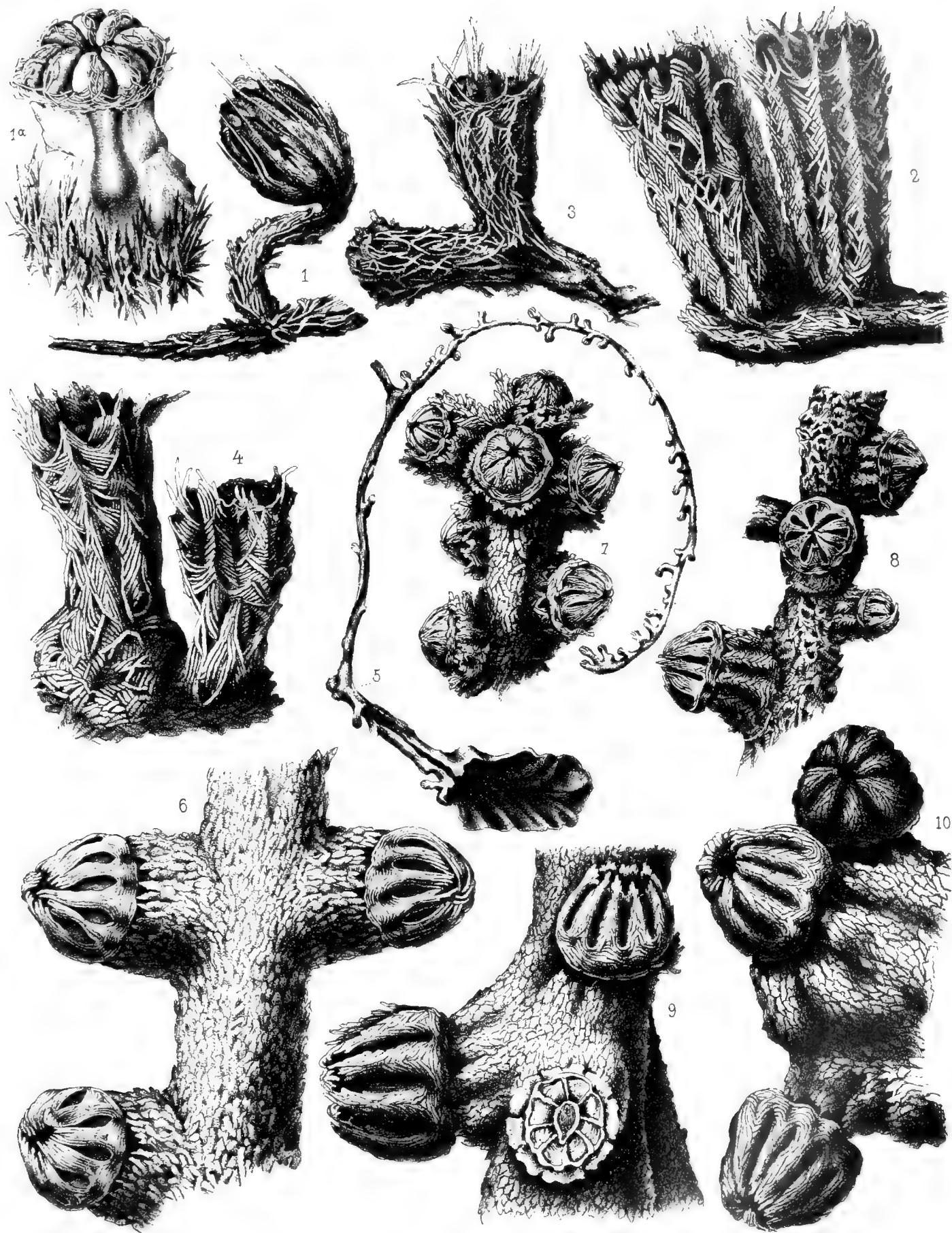


Plav. page 11 H.M.S. "Challenger"

THOUARELLA AMPHILAPHIS PLUMARELLA PRIMNOELLA CALIGORCIA PRIMNOIDES

# PLATE XXII.

	Page
Fig. 1. Polyp of <i>Acanthogorgia longiflora</i> , n. sp., . . . . .	94
Fig. 1a. „ <i>Paramuricea</i> , partially extended, showing œsophageal portion, tentacles withdrawn; with tentacular coronet of spicules. . . . .	
Fig. 2. „ <i>Acanthogorgia laxa</i> , n. sp., . . . . .	96
Fig. 3. „ „ <i>ridleyi</i> , n. sp., . . . . .	95
Fig. 4. „ „ <i>ramossissima</i> , n. sp., . . . . .	97
Fig. 5. <i>Muriceides fragilis</i> , n. sp. Colony; natural size, . . . . .	105
Fig. 6. Polyps of <i>Paramuricea æquatorialis</i> , n. sp., . . . . .	100
Fig. 7. „ „ <i>ramosa</i> , n. sp., . . . . .	102
Fig. 8. „ „ <i>laxa</i> , n. sp., . . . . .	101
Fig. 9. „ <i>Clematissa robusta</i> , n. sp., . . . . .	108
Fig. 10. „ „ <i>verrilli</i> , n. sp., . . . . .	107



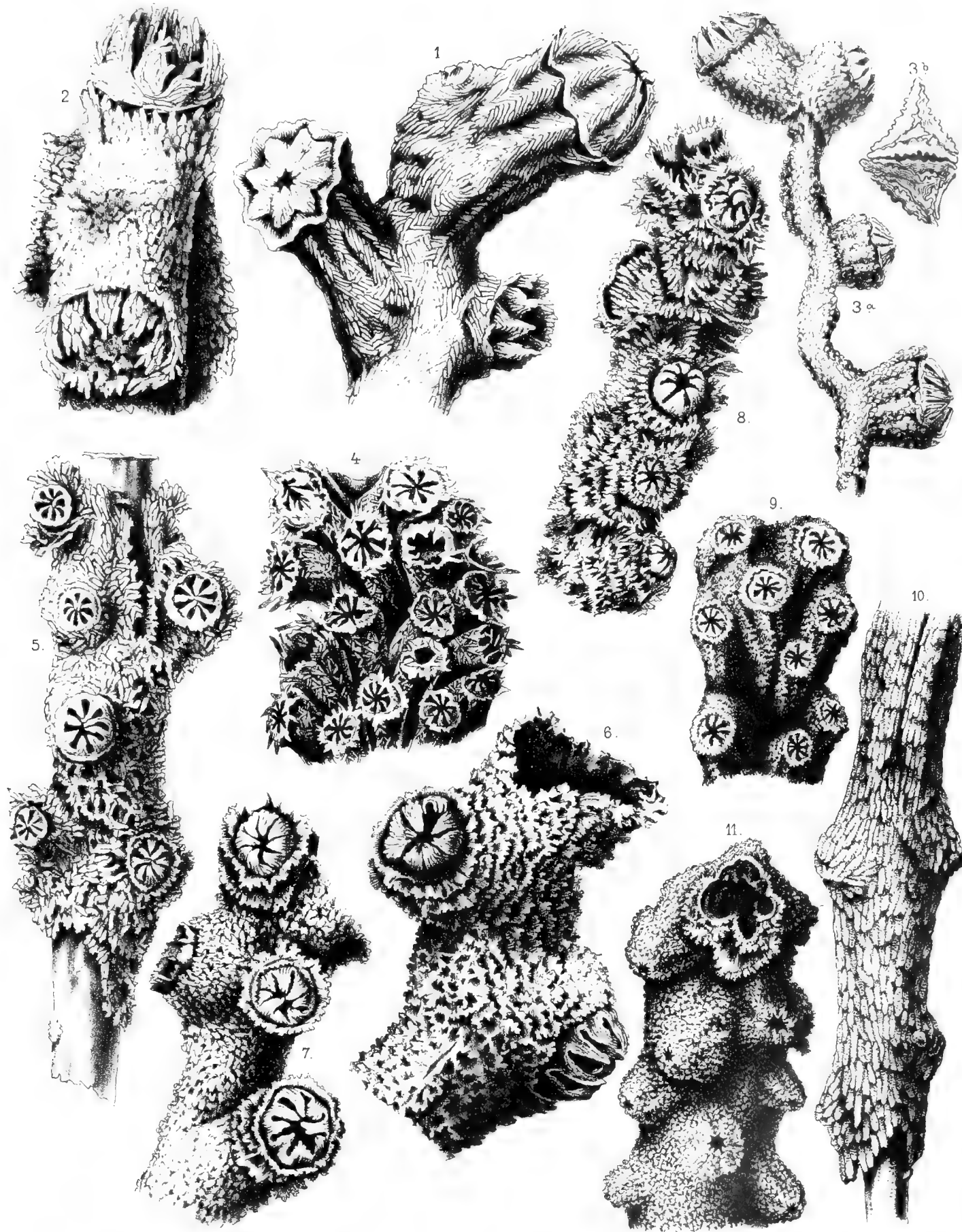
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ACANTHOGORGIA. PARAMURICEA. MURICEIDES. CLEMATESSA

# PLATE XXIII.

	Page
Fig. 1. Polyps of <i>Anthomuricea argentea</i> , n. sp., . . . . .	104
Fig. 2. „ <i>Clematissa obtusa</i> , n. sp., . . . . .	108
Fig. 3a. <i>Villogorgia intricata</i> (Gray). Branch with polyps, . . . . .	111
Fig. 3b. „ „ Two of the tentacular opercula.	
Fig. 4. Polyps of <i>Echinomuricea indomalaccensis</i> , Ridley, . . . . .	112
Fig. 5. „ <i>Placogorgia atlantica</i> , n. sp., . . . . .	114
Fig. 6. „ <i>Acamptogorgia alternans</i> , n. sp. ( <i>Perisceles</i> , in error on Plate), . . . . .	117
Fig. 7. „ „ <i>arbuscula</i> (Gray, MS.), . . . . .	116
Fig. 8. „ <i>Echinogorgia ramulosa</i> (Gray), . . . . .	120
Fig. 9. „ „ <i>pseudosassapo</i> , K��lliker, . . . . .	119
Fig. 10. „ <i>Elasmogorgia filiformis</i> , n. sp. ( <i>Elasma</i> , in error on Plate),	133
Fig. 11. „ <i>Muricea bicolor</i> , n. sp., . . . . .	134





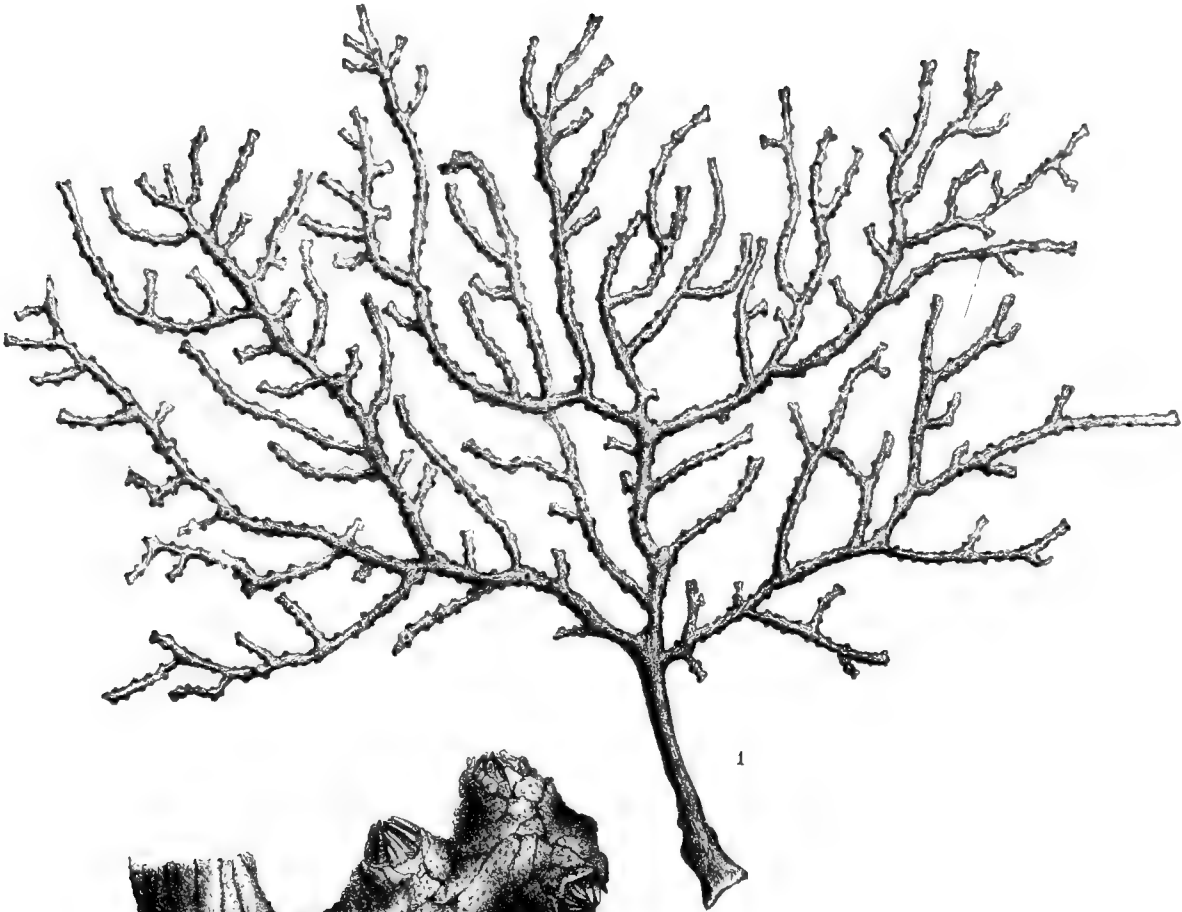
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ANTHOMURICEA . CLEMATESSA . VILLOGORGIA . ECHINOMURICEA . PLACOGORGIA .  
PERISCELES . ECHINOGORGIA . ELASMA . MURICEA .

# PLATE XXIV.

	Page
Fig. 1. <i>Acis pustulata</i> , n. sp. Natural size, . . . . .	122
Fig. 1a. „ „ Branch with polyps ; enlarged.	
Fig. 2. <i>Siphonogorgia köllikeri</i> , n. sp. Polyps ; enlarged, . . . . .	236





ACIS. SIPHONOGORGIA.

# PLATE XXV.

	Page
Fig. 1. Spicules of <i>Muriceides fragilis</i> , n. sp., . . . . .	105
Fig. 2. „ <i>Acanthogorgia ridleyi</i> , n. sp., . . . . .	95
Fig. 3. „ „ <i>laxa</i> , n. sp., . . . . .	96
Fig. 4. „ „ <i>longiflora</i> , n. sp., . . . . .	94
Fig. 5. „ <i>Echinogorgia pseudosassapo</i> , K��lliker, . . . . .	119
Fig. 6. „ „ <i>ramulosa</i> (Gray), . . . . .	120
Fig. 7. „ <i>Muricella gracilis</i> , n. sp., . . . . .	129
Fig. 8. „ <i>Muricea bicolor</i> , n. sp., . . . . .	134



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MURICEIDES. ACANTHOGORGIA ECHINOGORGIA. MURICELLA. MURICEA.

# PLATE XXVI.

	Page
Fig. 1. Spicules of <i>Paramuricea ramosa</i> , n. sp., . . . . .	102
Fig. 2. „ „ „ <i>laxa</i> , n. sp., . . . . .	101
Fig. 3. „ „ „ <i>æquatorialis</i> , n. sp., . . . . .	100
Fig. 4. „ „ <i>Clematissa obtusa</i> , n. sp., . . . . .	108
Fig. 5. „ „ „ <i>robusta</i> , n. sp., . . . . .	108
Fig. 6. „ „ „ <i>verrilli</i> , n. sp., . . . . .	107
Fig. 7. „ „ <i>Acanthogorgia ramossissima</i> , n. sp., . . . . .	97
Fig. 8. „ „ <i>Placogorgia atlantica</i> , n. sp., . . . . .	114
Fig. 9. „ „ <i>Anthomuricea argentea</i> , n. sp., . . . . .	104



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PARAMURICEA. CLEMATESSA ACANTHOGORGIA ANTHOMURICEA PLACOGORGIA

# PLATE XXVII.

	Page
Fig. 1. Spicules of <i>Villogorgia intricata</i> (Gray), . . . . .	111
Fig. 2. „ <i>Placogorgia atlantica</i> , n. sp., . . . . .	114
Fig. 3. „ <i>Echinomuricea indomalaccensis</i> , Ridley, . . . . .	112
Fig. 4. „ <i>Acamptogorgia alternans</i> , n. sp. ( <i>Perisceles</i> , in error on Plate), . . . . .	117
Fig. 5. „ „ <i>arbuscula</i> (Gray, MS.), . . . . .	116
Fig. 6. „ <i>Acis pustulata</i> , n. sp., . . . . .	122
Fig. 7. „ <i>Elasmogorgia filiformis</i> , n. sp. ( <i>Elasma</i> , in error on Plate),	133



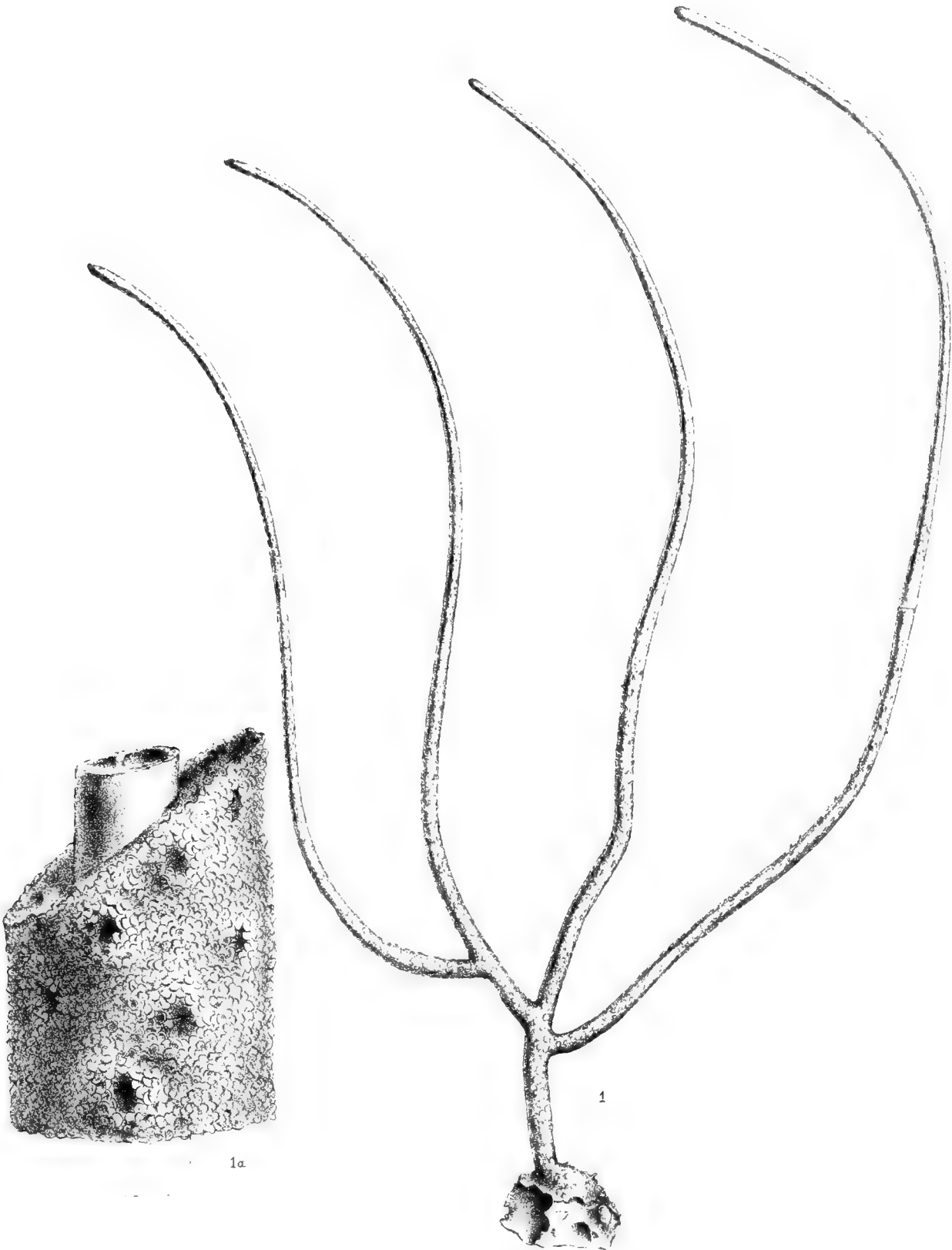
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VILLOGORGIA PLACOGORGIA. ECHINOMURICEA PERISCELES ACIS. ELASMA.

# PLATE XXVIII.

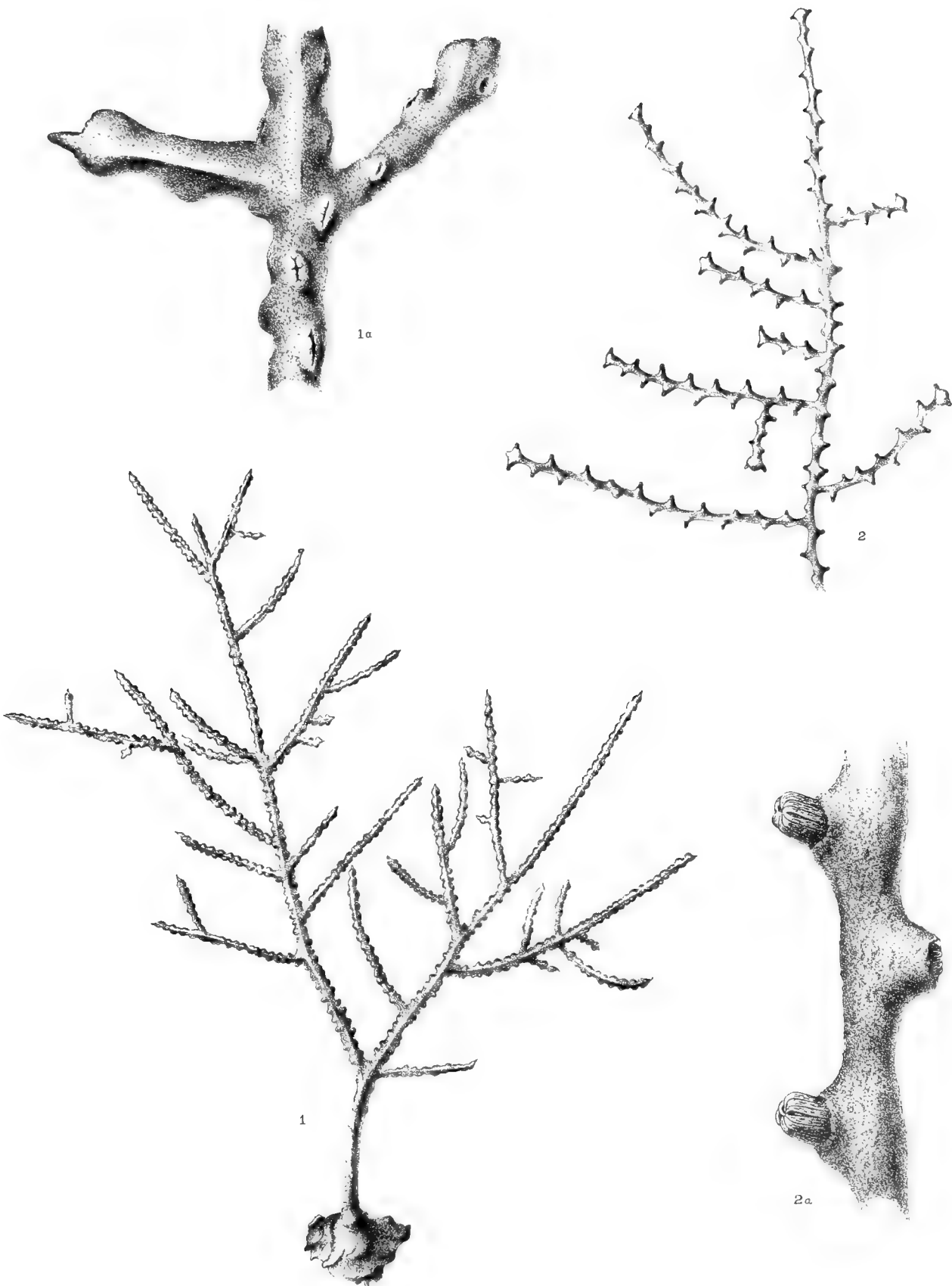
		Page
Fig 1.	<i>Plexauroides prælonga</i> (Ridley). Colony ; natural size ( <i>Plexaura</i> on Plate), . . . . .	138
Fig. 1a.	„ „ Portion of axis; magnified, showing cœnenchyma, with polyps.	





# PLATE XXIX.

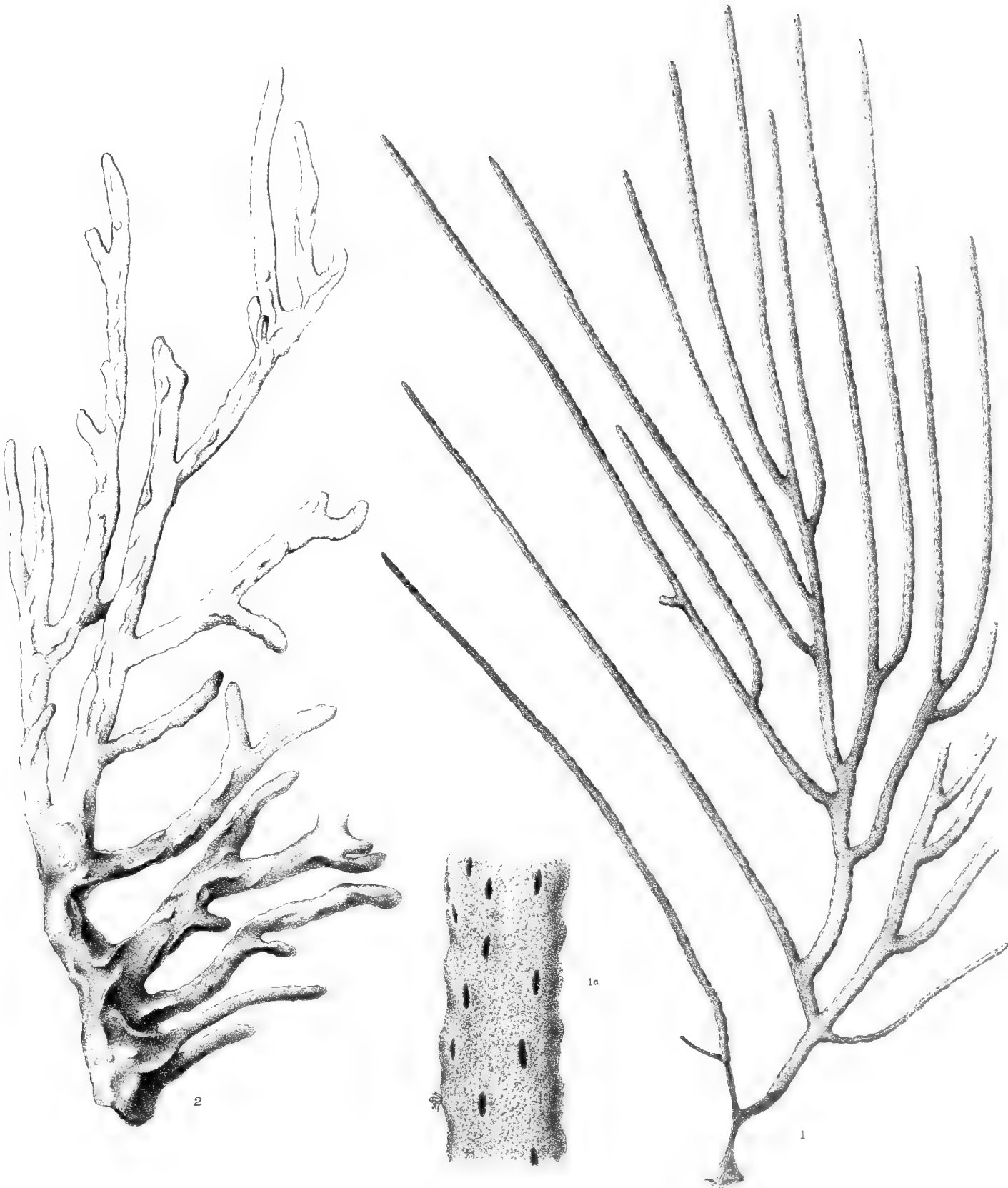
		Page
Fig. 1.	<i>Leptogorgia purpurea</i> (Pallas). Natural size, . . . . .	151
Fig. 1a.	„ „ Portion of a branch ; enlarged, with verrucæ.	
Fig. 2.	<i>Callistephanus koreni</i> , n. sp. Branch ; natural size, . . . . .	149
Fig. 2a.	„ „ Portion of a branch ; enlarged, with verrucæ and polyps partly extruded.	



LEPTOGORGIA. CALLISTEPHANUS.

# PLATE XXX.

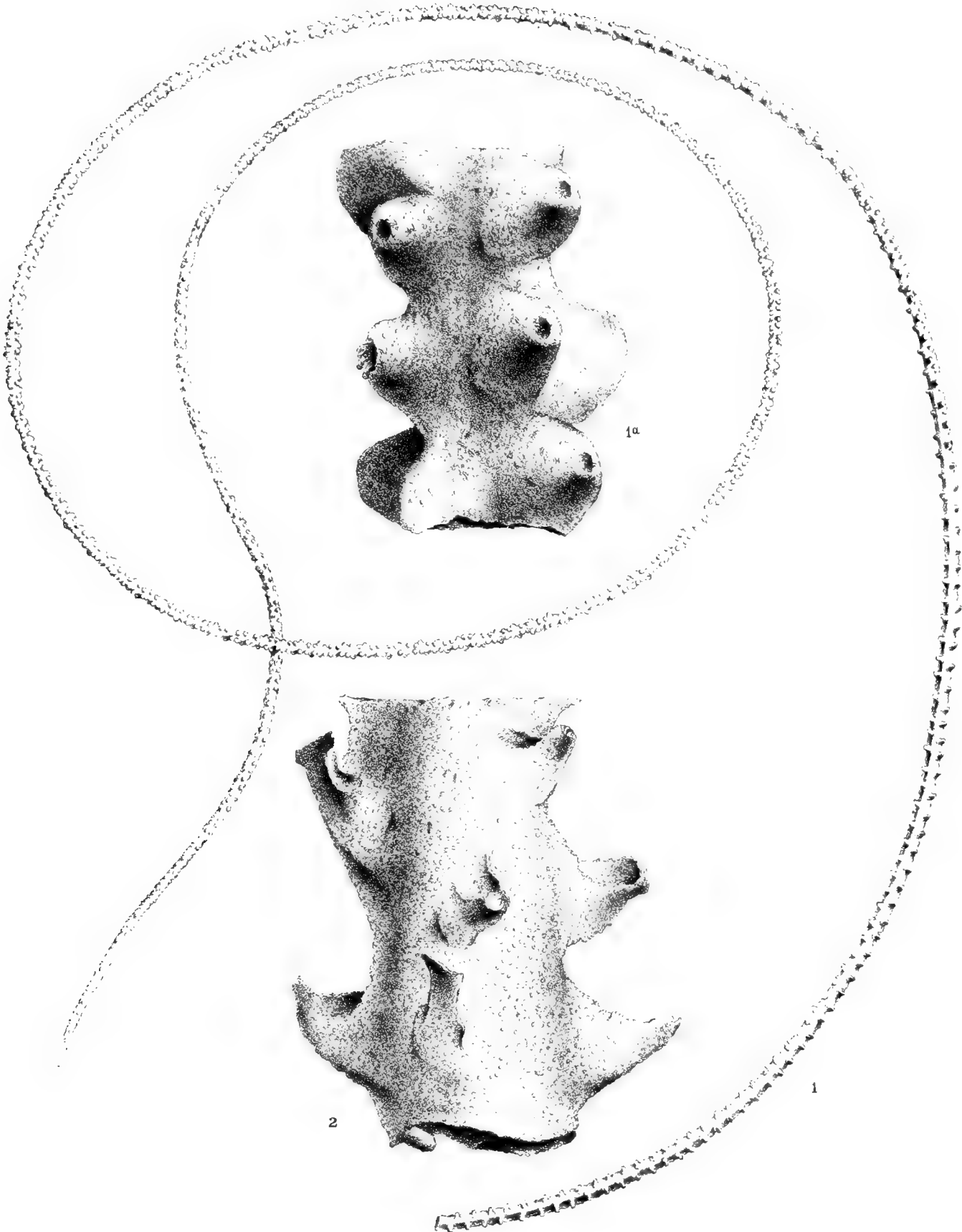
Fig. 1.	<i>Lophogorgia lutkeni</i> , n. sp.	Part of colony ; natural size.	( <i>Leptogorgia</i>	Page
		on Plate),	.	150
Fig. 1a.	"	Portion of a branch ; enlarged.		
Fig. 2.	<i>Iciligorgia orientalis</i> , Ridley.	Natural size,	.	164



ICILOGORGIA. LEPTOGORGIA.

# PLATE XXXI.

		Page
Fig. 1.	<i>Scirpearella gracilis</i> , n. sp. The entire colony ; natural size, .	156
Fig. 1a.	„ „ Portion enlarged, showing verrucæ.	
Fig. 2.	„ <i>profunda</i> , n. sp. Small portion of colony ; enlarged, .	155

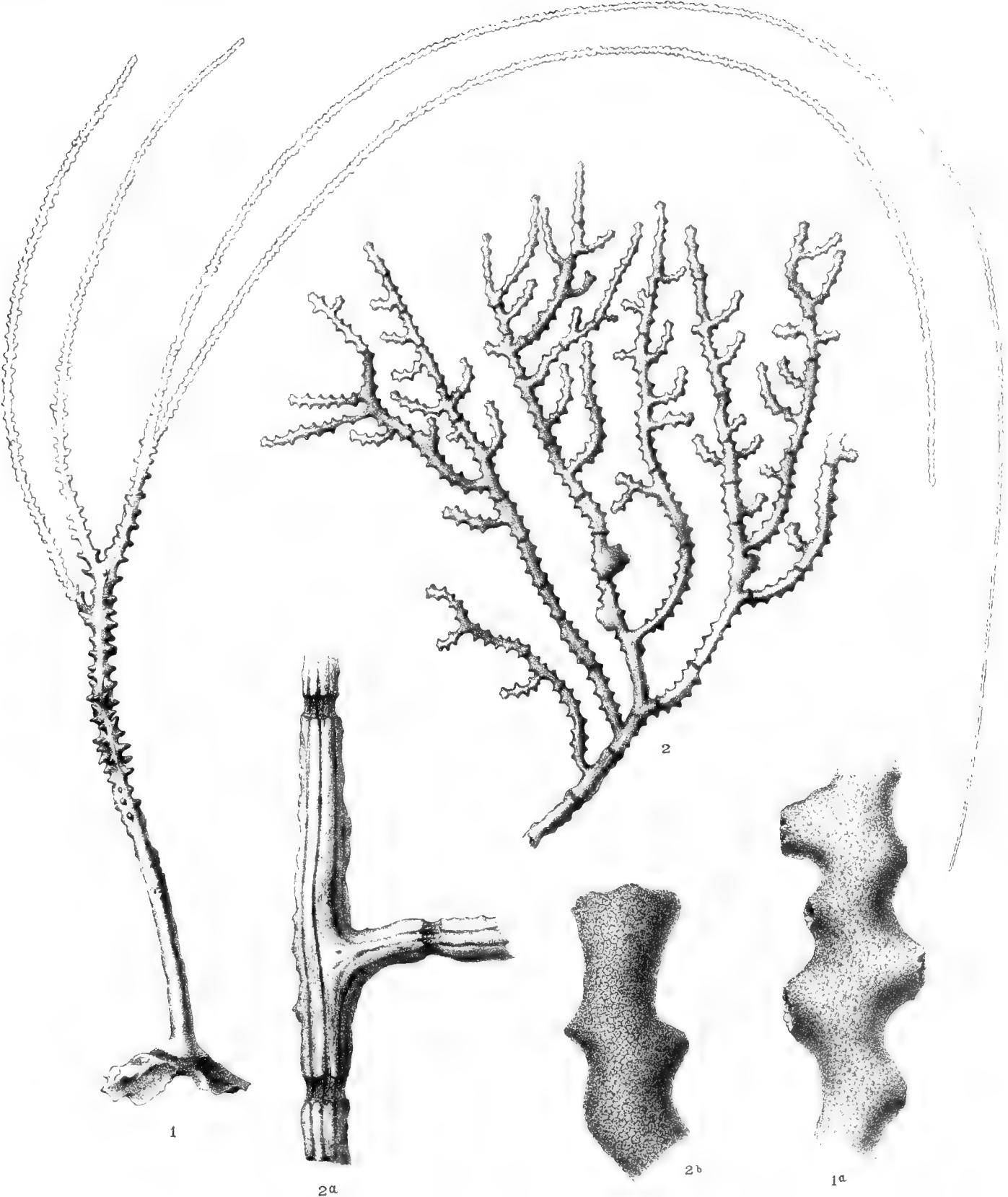


SCIRPEARELLA.

# PLATE XXXII.

Fig. 1.	<i>Scirpearella profunda</i> , n. sp.	Colony, partially restored,		Page
				155
Fig. 1 <i>a</i> .	„	„	Polyps from end of a branch ; enlarged.	
Fig. 2.	<i>Parisis fruticosa</i> , Verrill.	Portion of colony,		182
Fig. 2 <i>a</i> .	„	„	Axis, deprived of cœenchyma ; showing branching, enlarged.	
Fig. 2 <i>b</i> .	„	„	Terminal portion of a branch ; enlarged.	





SCIRPEARELLA. PARISIS.

# PLATE XXXIII.

	Page
Fig. 1. Spicules of <i>Plexaura valenciennesi</i> , n. sp., . . . . .	137
Fig. 2. „ <i>Plexauroides prælonga</i> (Ridley), . . . . .	138
Fig. 3. „ <i>Pseudoplexaura crassa</i> (Ellis and Solander), . . . . .	142
Fig. 4. „ <i>Plexaurella phillipinensis</i> , n. sp., . . . . .	140
Fig. 5. „ <i>Euplexaura pinnata</i> , n. sp., . . . . .	144
Fig. 6. „ „ <i>parciclados</i> , n. sp., . . . . .	144
Fig. 7. „ <i>Callistephanus koreni</i> , n. sp., . . . . .	149
Fig. 8. „ <i>Platycaulos danielsseni</i> , n. sp., . . . . .	147

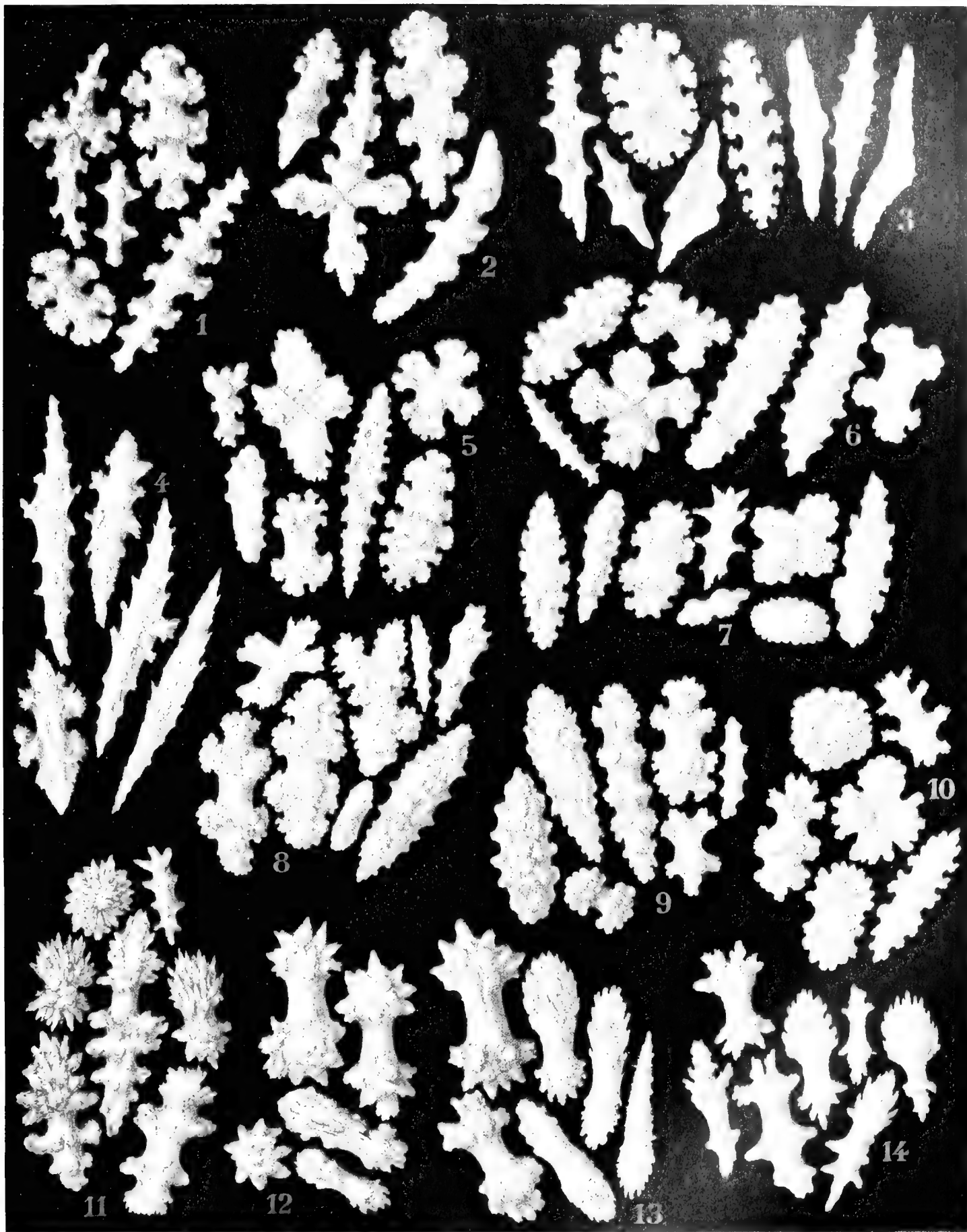


PLEXAURA PLEXAUROIDES PSEUDOPLEXAURA PLEXAURELLA EUPLEXAURA

CALLISTEPHANUS PLATYCAULOS

# PLATE XXXIV.

Fig. 1.	Spicules of <i>Lophogorgia lutkeni</i> , n. sp.,	Page 150
Fig. 2.	„ <i>Leptogorgia torresia</i> , n. sp.,	152
Fig. 3.	„ „ <i>purpurea</i> (Pallas),	151
Fig. 4.	„ „ <i>arbuscula</i> (Philippi),	152
Fig. 5.	„ <i>Scirpearella rubra</i> , n. sp.,	157
Fig. 6.	„ „ <i>gracilis</i> , n. sp.,	156
Fig. 7.	„ „ <i>profunda</i> , n. sp.,	155
Fig. 8.	„ „ <i>moniliforme</i> , n. sp.,	156
Fig. 9.	„ <i>Ellisella maculata</i> , Studer,	160
Fig. 10.	„ <i>Gorgonella orientalis</i> , n. sp.,	161
Fig. 11.	„ <i>Juncella racemosa</i> , n. sp.,	159
Fig. 12.	„ „ <i>junceae</i> (Pallas), var. <i>alba</i> , n.,	158
Fig. 13.	„ „ <i>gemmacea</i> (Valenciennes),	158
Fig. 14.	„ „ <i>barbadensis</i> , Duchassaing and Michelotti,	159

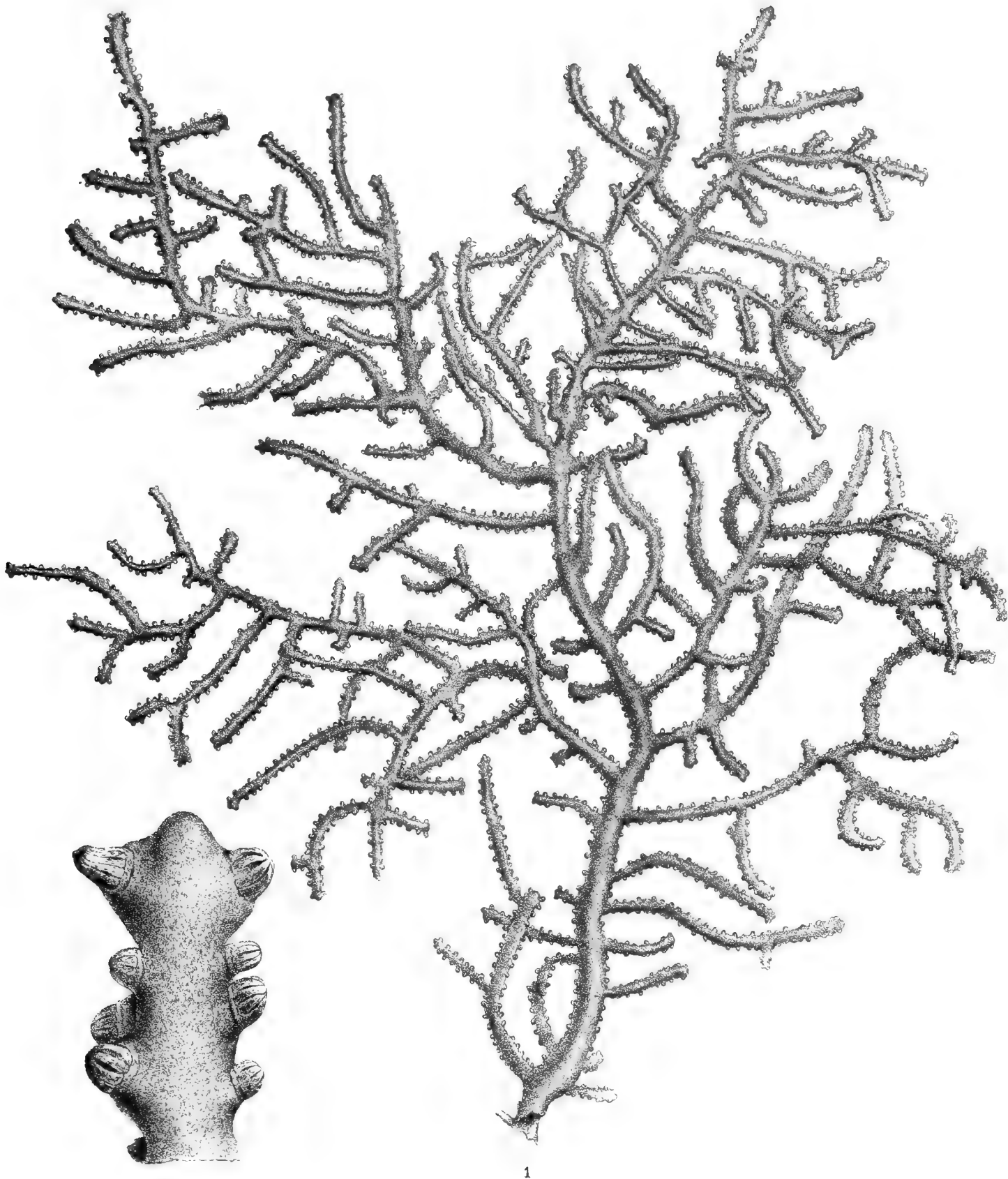


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LOPHOGORGIA LEPTOGORGIA SCIRPEARELLA ELLISELLA GORGONELLA JUNCCELLA

PLATE XXXV.

		Page
Fig. 1.	<i>Platycaulos danielsseni</i> , n. sp. Colony; natural size, . . . . .	147
Fig. 1a.	„ „ „ „ „ Terminal portion of a branch with polyps; enlarged.	



1a

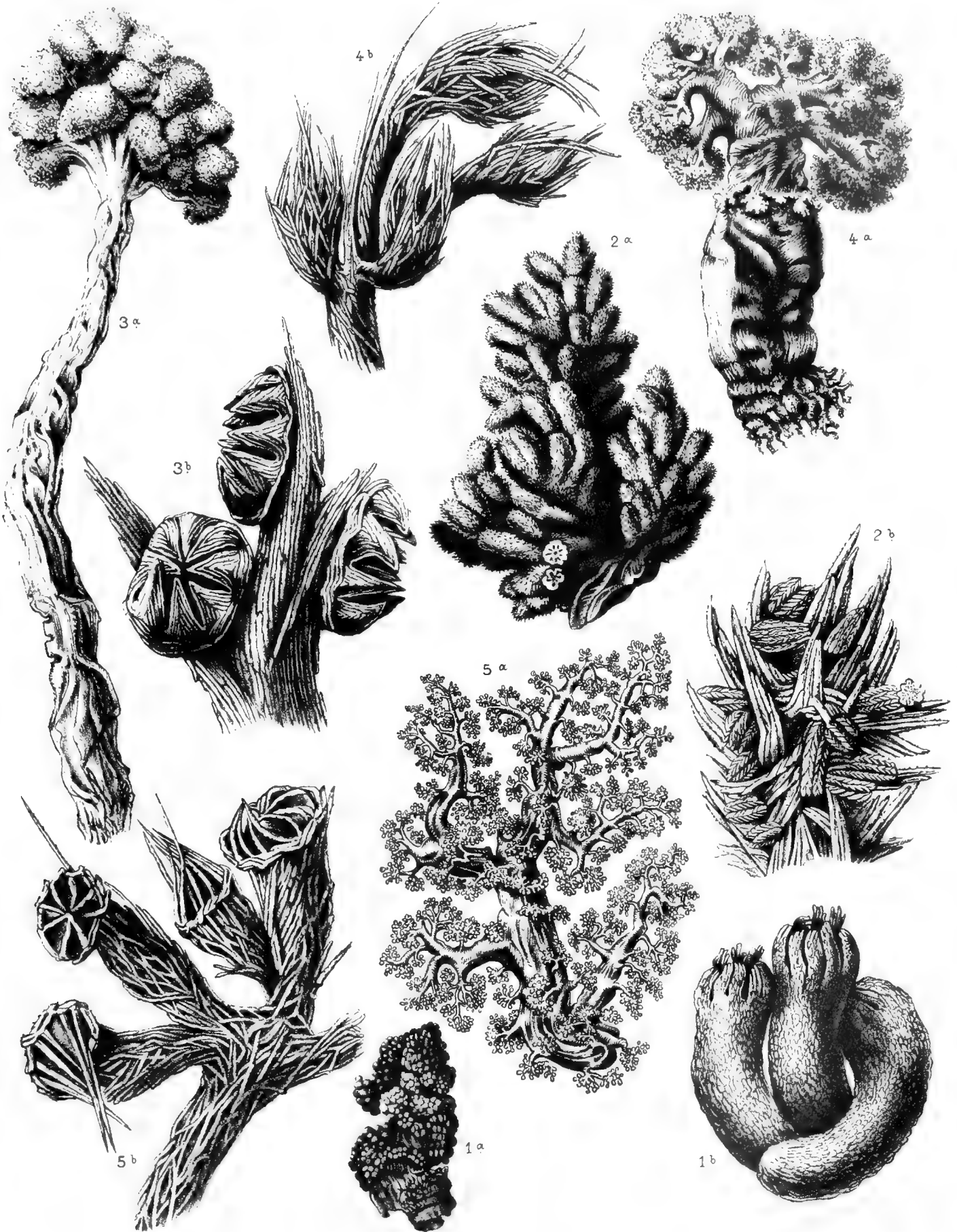
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PLATYCAULOS.

# PLATE XXXVI.

	Page
Fig. 1 <i>a</i> . <i>Eunephthya fusca</i> , n. sp. Colony ; natural size, . . .	190
Fig. 1 <i>b</i> . „ „ Polyps ; enlarged.	
Fig. 2 <i>a</i> . <i>Spongodes digitata</i> , n. sp. Colony ; natural size, . . .	193
Fig. 2 <i>b</i> . „ „ Small branch ; enlarged.	
Fig. 3 <i>a</i> . „ „ <i>anguina</i> , n. sp. Colony ; natural size, . . .	205
Fig. 3 <i>b</i> . „ „ Terminal branch ; enlarged.	
Fig. 4 <i>a</i> . „ „ <i>collaris</i> , n. sp. Colony ; natural size, . . .	208
Fig. 4 <i>b</i> . „ „ Terminal branch ; enlarged.	
Fig. 5 <i>a</i> . „ „ <i>laxa</i> , n. sp. Colony ; natural size, . . .	217
Fig. 5 <i>b</i> . „ „ Polyps ; enlarged.	



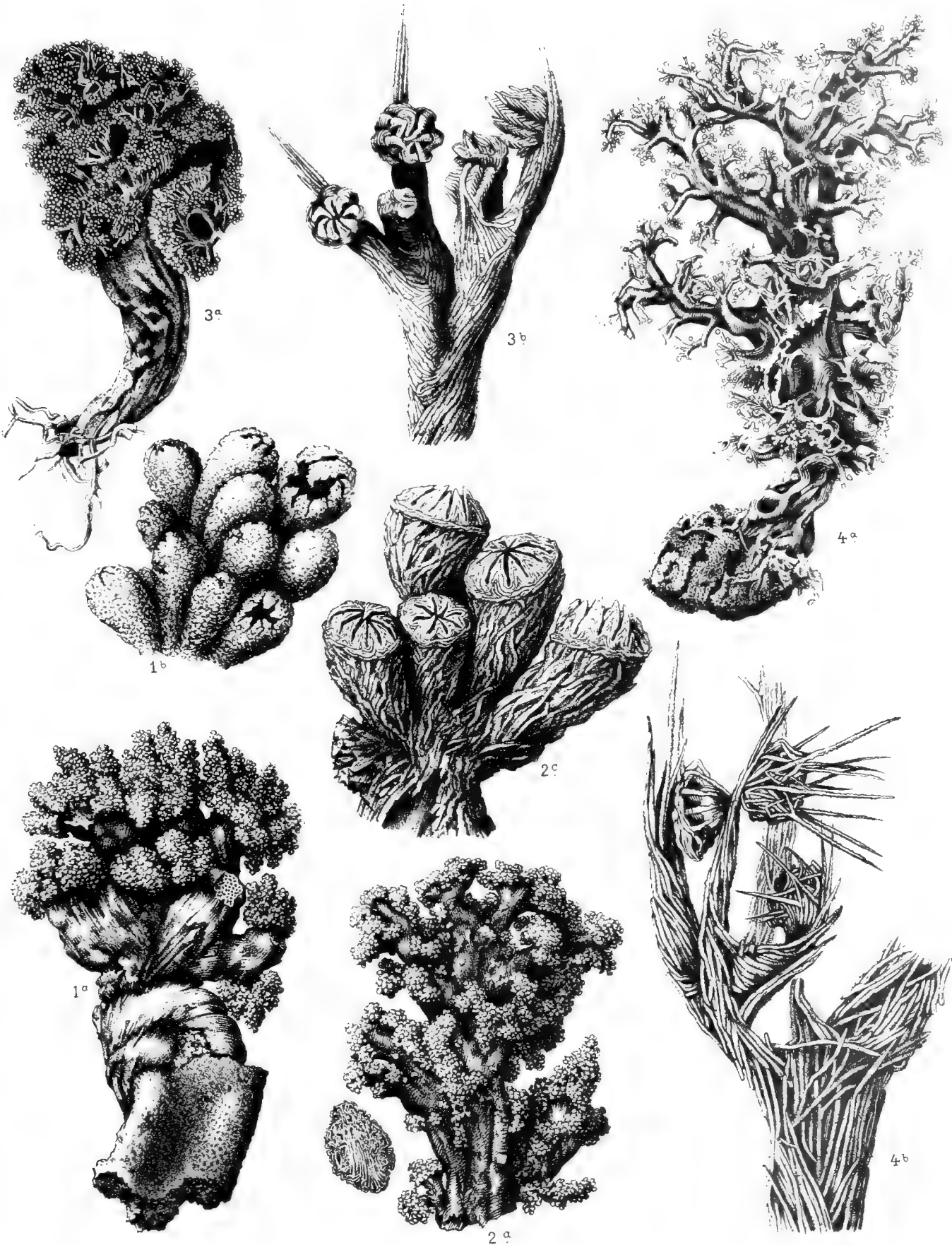


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SPONGODES. EUNEPHTHYA

# PLATE XXXVIA.

	Page
Fig. 1 <i>a</i> . <i>Paranephthya capitulifera</i> , n. sp. Natural size,	227
Fig. 1 <i>b</i> .           ,,                   ,,           Polyps ; enlarged.	
Fig. 2 <i>a</i> . <i>Scleronephthya pustulosa</i> , n. sp. Natural size,	229
Fig. 2 <i>c</i> .           ,,                   ,,           Polyps ; enlarged.	
Fig. 3 <i>a</i> . <i>Spongodes pustulosa</i> , n. sp. Colony ; natural size,	213
Fig. 3 <i>b</i> .           ,,                   ,,           Terminal branch ; enlarged.	
Fig. 4 <i>a</i> .           ,, <i>rhodosticta</i> , n. sp. Colony ; natural size,	218
Fig. 4 <i>b</i> .           ,,                   ,,           Terminal twig ; enlarged.	

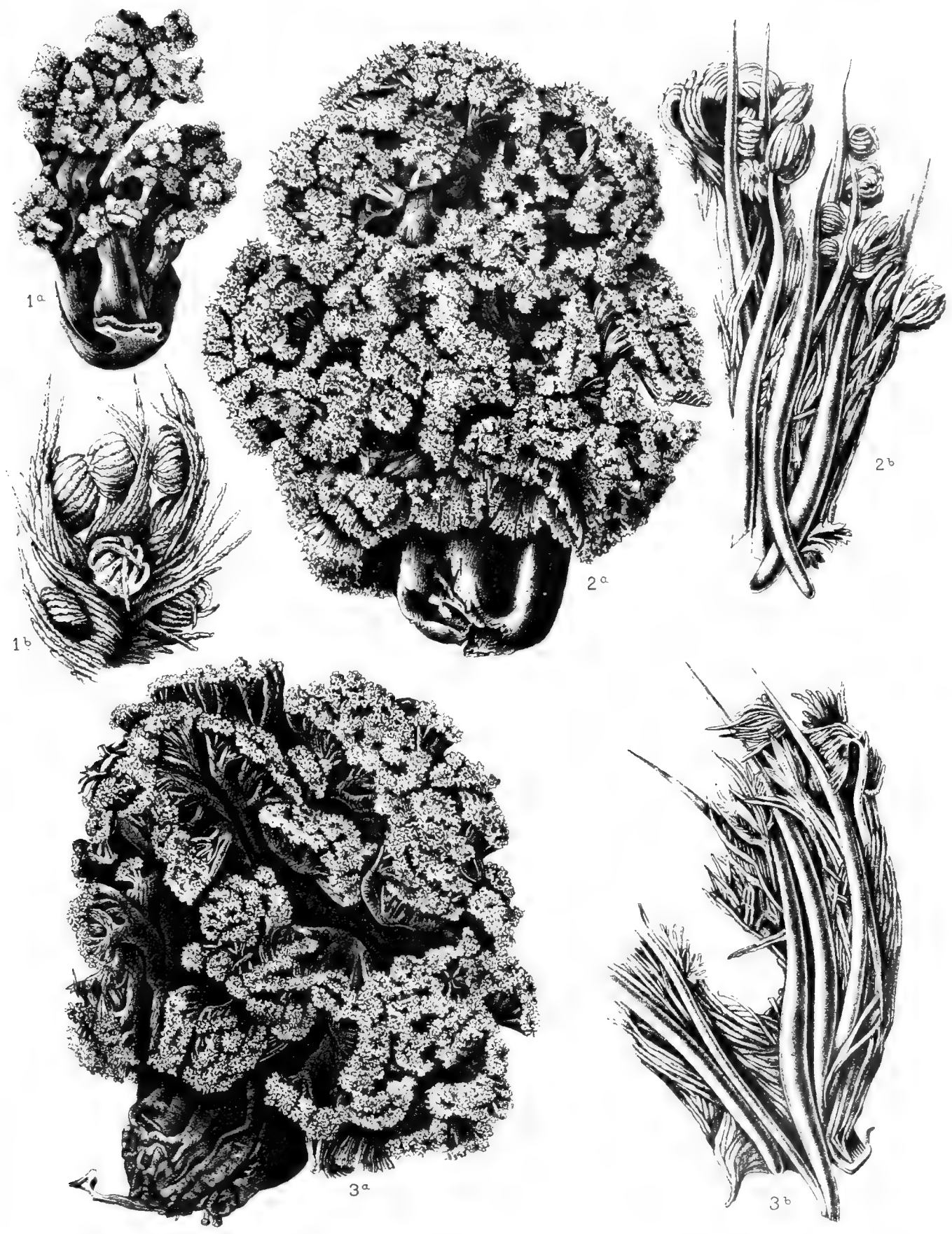


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PARANEPHTHYA . SCLERONEPHTHYA . SPONGODES .

# PLATE XXXVI<sub>B</sub>.

					Page
Fig. 1 <i>a</i> .	<i>Spongodes nephthyæformis</i> , n. sp.	Colony ; natural size,	.	.	195
Fig. 1 <i>b</i> .	„ „	Portion, with polyps ; enlarged.			
Fig. 2 <i>a</i> .	„ <i>macrospina</i> , n. sp.	Colony ; natural size,	.	.	199
Fig. 2 <i>b</i> .	„ „	Polyps ; enlarged.			
Fig. 3 <i>a</i> .	„ <i>corymbosa</i> , n. sp.	Colony ; natural size,	.	.	201
Fig. 3 <i>b</i> .	„ „	Portion ; enlarged.			



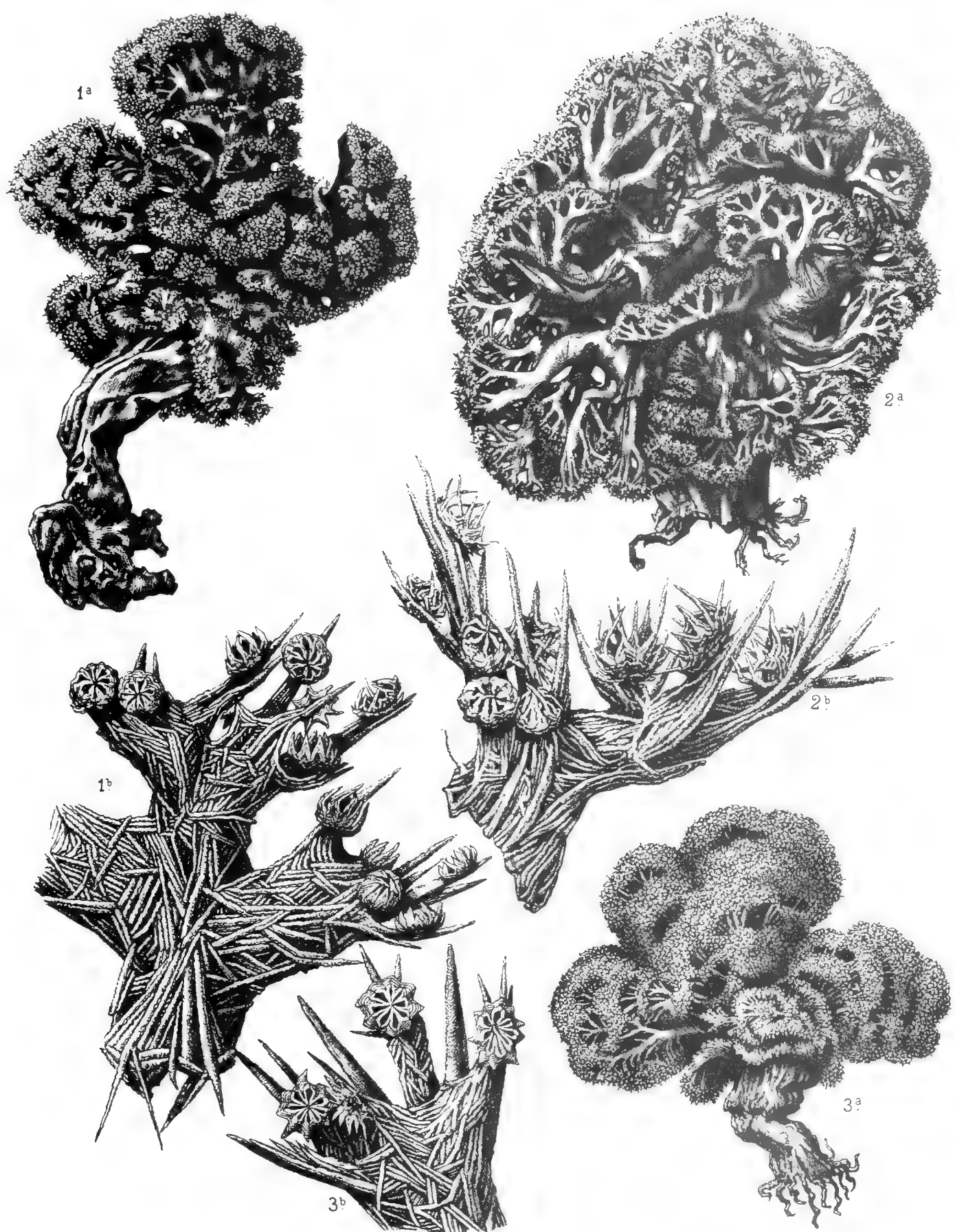
P. Armbruster Bonn del. J. H. et. sculp.

SPONGODES.

# PLATE XXXVIc.

Fig. 1 <i>a</i> .	<i>Spongodes bicolor</i> , n. sp.	Colony ; natural size,	.	.	.	Page 207
Fig. 1 <i>b</i> .	„	„	Portion ; enlarged.			
Fig. 2 <i>a</i> .	„	<i>dendrophyta</i> , n. sp.	Colony ; natural size,	.	.	204
Fig. 2 <i>b</i> .	„	„	Portion ; enlarged.			
Fig. 3 <i>a</i> .	„	<i>monticulosa</i> , n. sp.	Colony ; natural size,	.	.	215
Fig. 3 <i>b</i> .	„	„	Portion ; enlarged.			





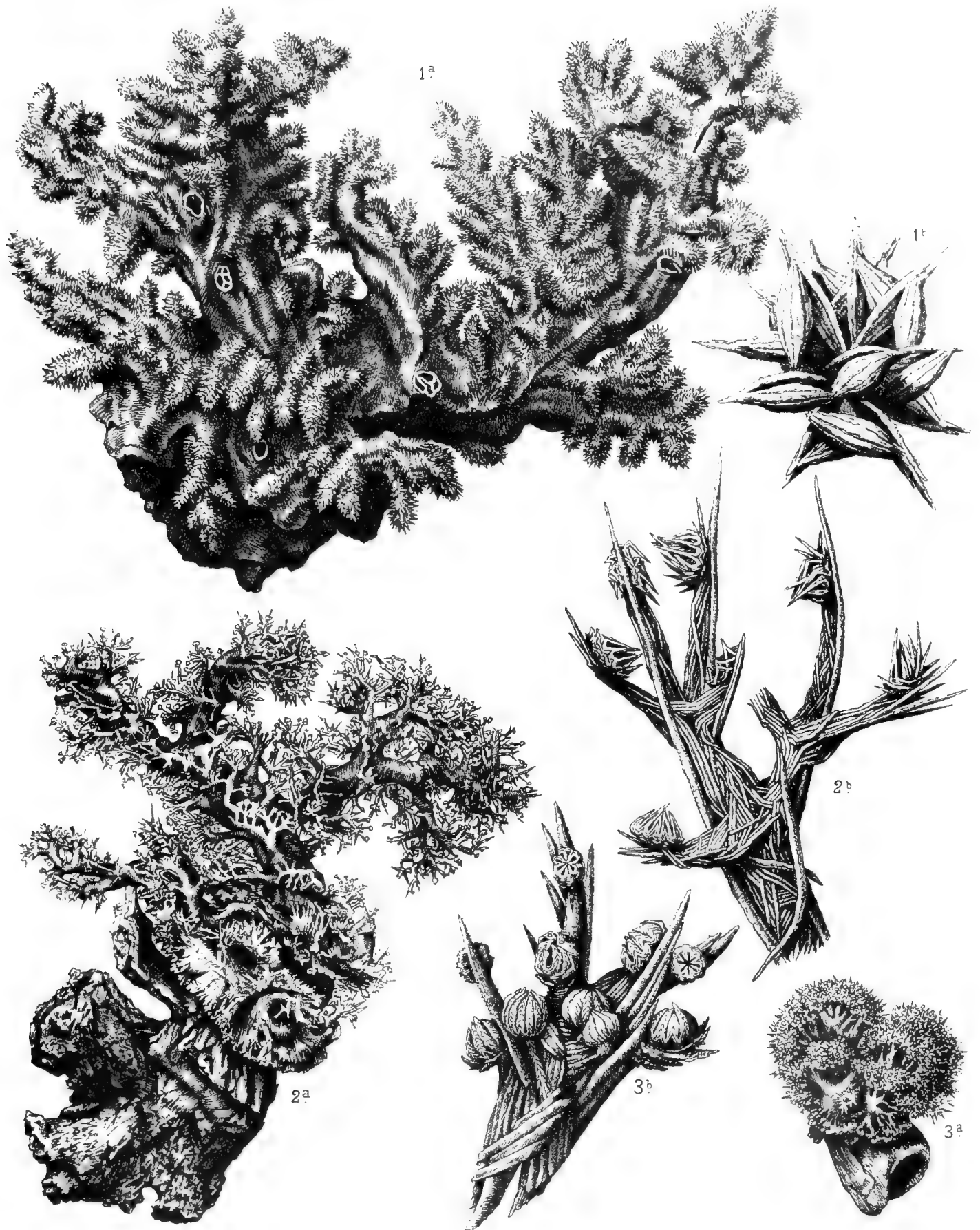
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SPONGODES.

# PLATE XXXVIb.

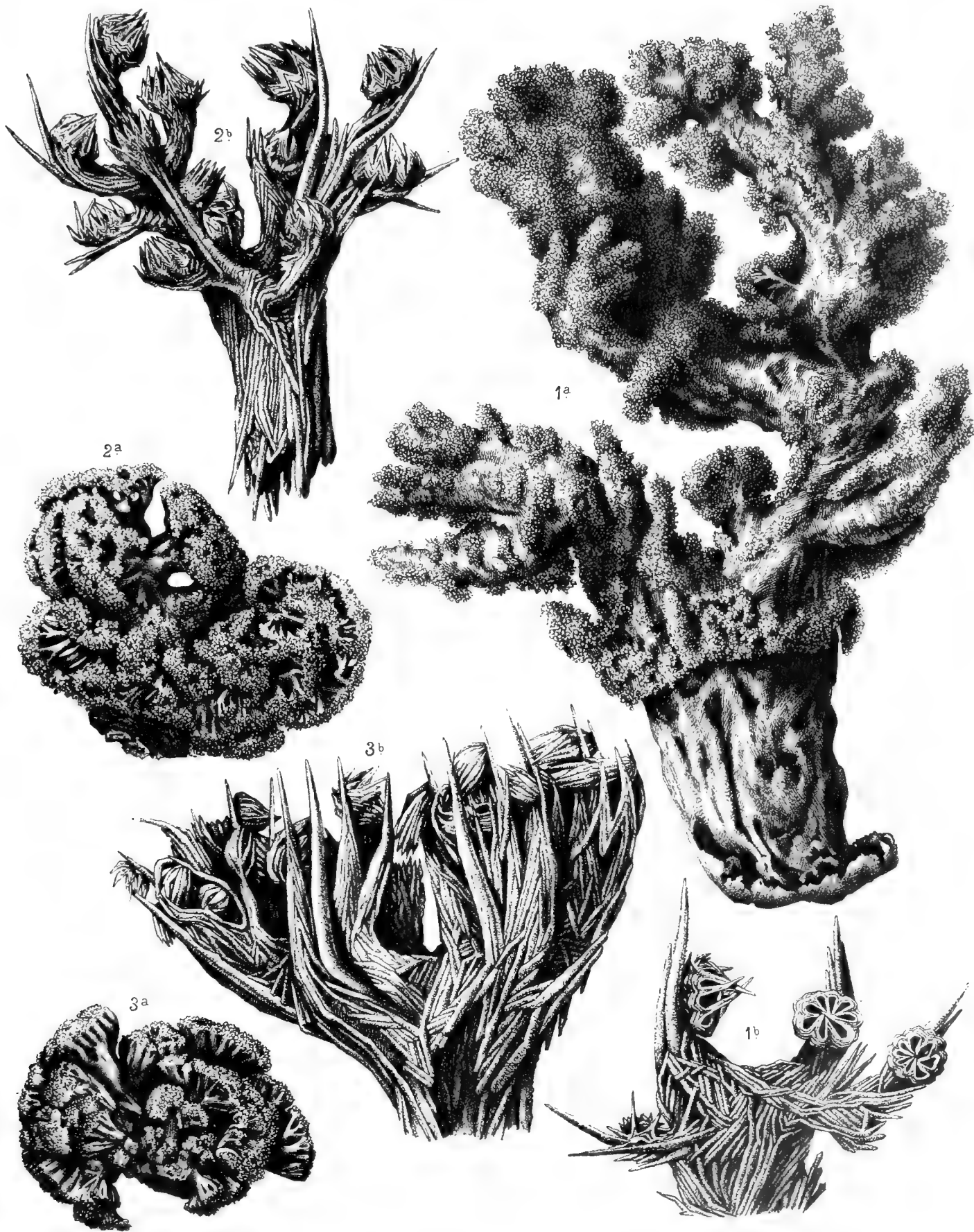
Fig. 1a.	<i>Spongodes spicata</i> , n. sp.	Colony; natural size,	.	.	.	Page 194
Fig. 1b.	„	„	Polyps ; enlarged.			
Fig. 2a.	„	<i>cervicornis</i> , n. sp.	Colony ; natural size,	.	.	220
Fig. 2b.	„	„	Portion ; enlarged.			
Fig. 3a.	„	<i>heterocyathus</i> , n. sp.	Colony ; natural size,	.	.	210
Fig. 3b.	„	„	Polyps ; enlarged.			





# PLATE XXXVI.

				Page
Fig. 1 <i>a</i> .	<i>Spongodes carnea</i> , n. sp.	Colony ; natural size,	.	196
Fig. 1 <i>b</i> .	„	„ Polyps ; enlarged.		
Fig. 2 <i>a</i> .	„	<i>coronata</i> , n. sp. Colony ; natural size,	.	212
Fig. 2 <i>b</i> .	„	„ Portion with polyps ; enlarged.		
Fig. 3 <i>a</i> .	„	<i>umbellata</i> , n. sp. Colony ; natural size,	.	203
Fig. 3 <i>b</i> .	„	„ Portion with polyps ; enlarged.		

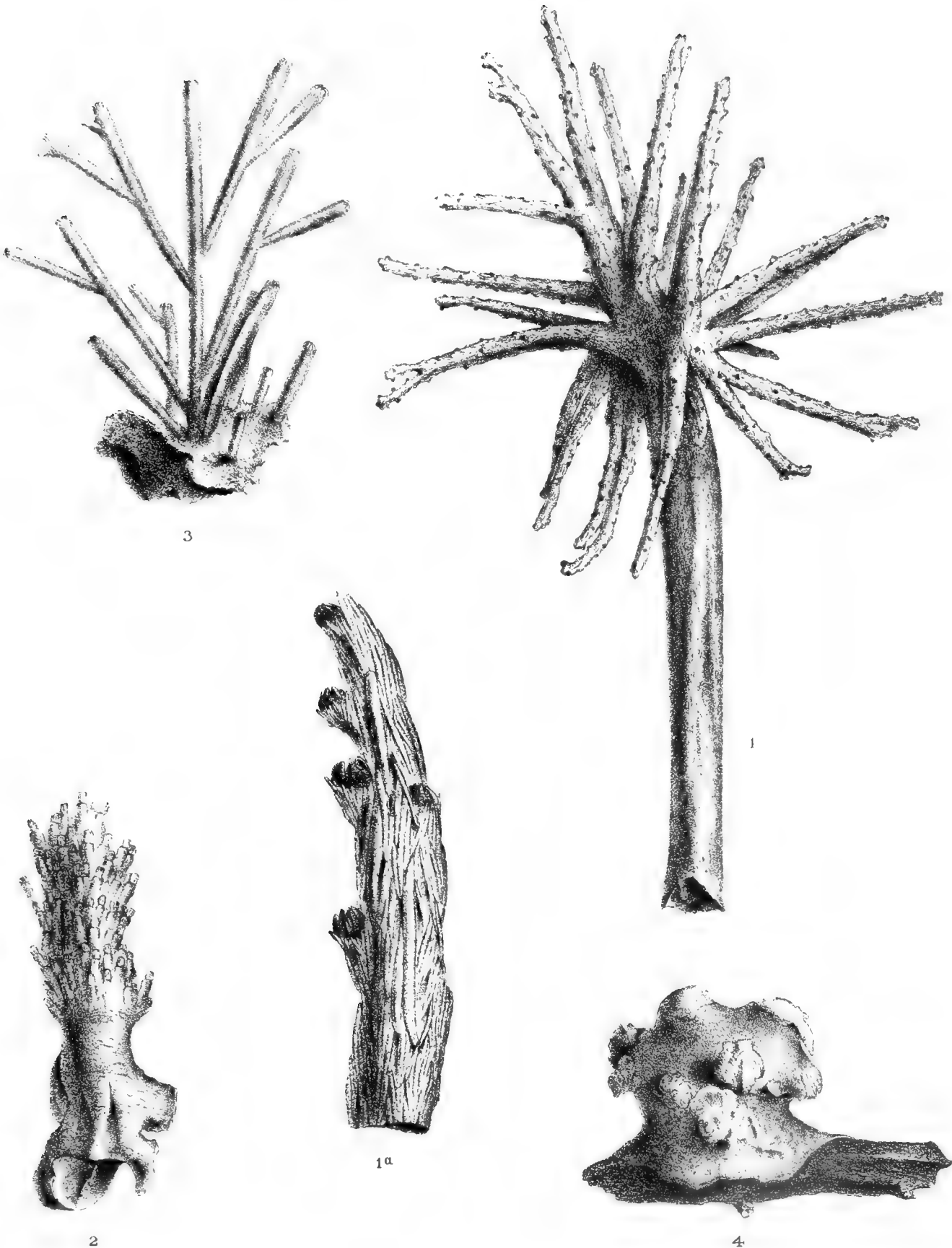


R. Arrindale, Bern, del. lith. et imp.

SPONGODES.

# PLATE XXXVII.

Fig. 1.	<i>Chironephthya dipsacea</i> , n. sp.	Colony ; natural size,	.	.	.	Page 231
Fig. 1a.	„	„	Portion ; enlarged.			
Fig. 2.	<i>Bellonella bocagei</i> (Kent).	Natural size,	.	.	.	241
Fig. 3.	<i>Telesto rigida</i> , n. sp.	Colony ; natural size,	.	.	.	261
Fig. 4.	<i>Anthomastus canariensis</i> , n. sp.	Natural size,	.	.	.	242



# PLATE XXXVIII.

	Page
Fig. 1. <i>Sarcophytum philippinensis</i> , n. sp. Natural size, . . .	246
Fig. 2. „ <i>tongatabuensis</i> , n. sp. Natural size, . . .	245
Fig. 3. <i>Chironephthya crassa</i> , n. sp. Portion of a colony; natural size, . .	234
Fig. 4. <i>Siphonogorgia godeffroyi</i> , K��lliker. Fragment of a young colony, .	236

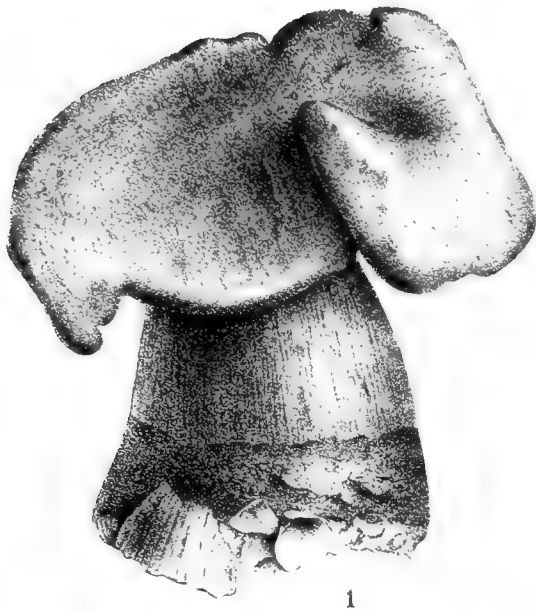


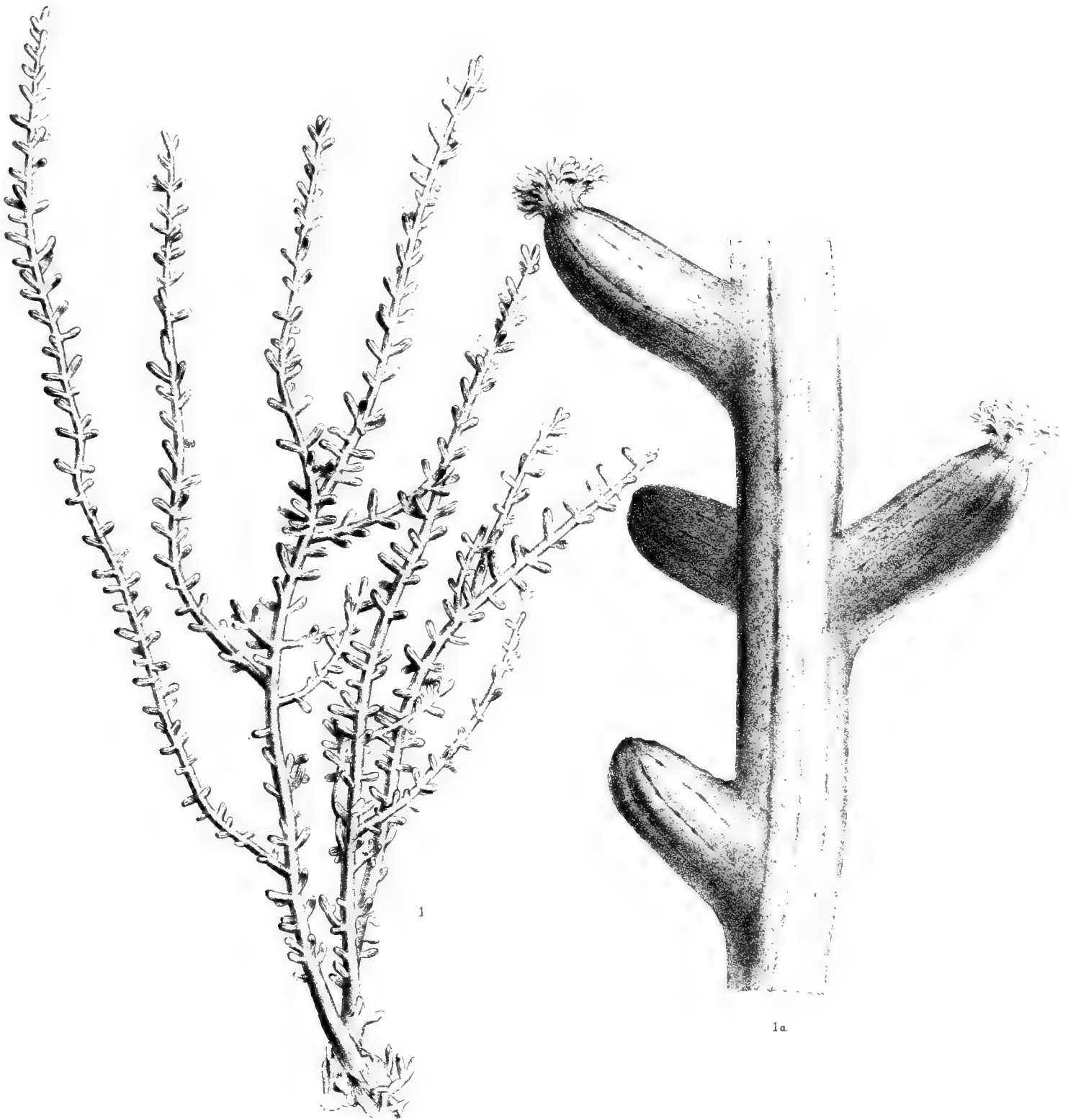
PLATE XXXIX.

Fig. 1. *Telesto arborea*, n. sp. Portion of a colony ; natural size,

Page  
262

Fig. 1*a*. „ „ Stem and polyps ; magnified.



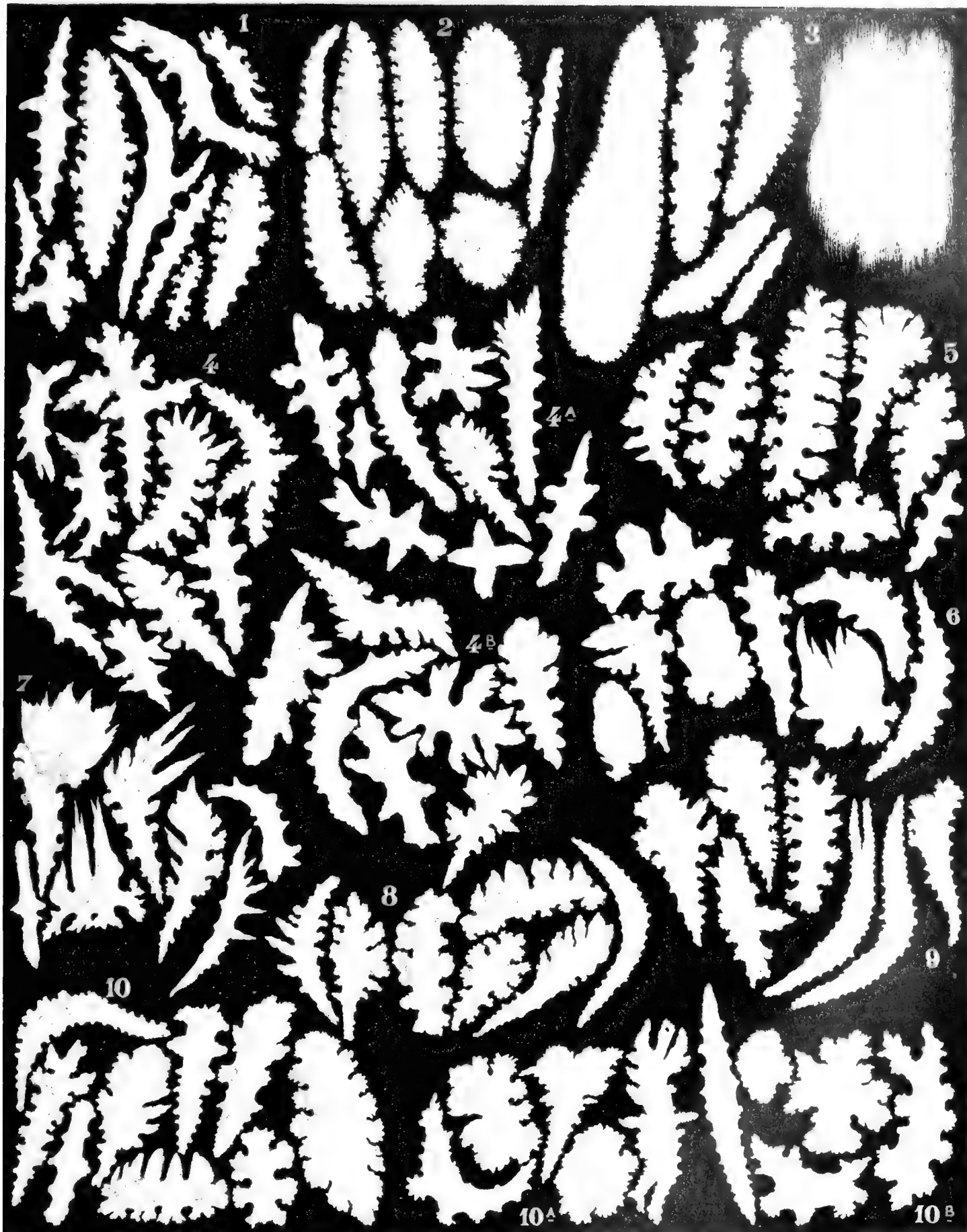


1a

TELESTO

# PLATE XL.

	Page
Fig. 1. Spicules of <i>Suberia genthi</i> , n. sp., . . . . .	163
Fig. 2. „ „ <i>Suberogorgia köllikeri</i> , n. sp., . . . . .	167
Fig. 3. „ „ <i>Keroeides koreni</i> , n. sp., . . . . .	169
Fig. 4. „ „ <i>Melitodes dichotoma</i> , n. sp., . . . . .	173
Fig. 4A. „ „ „ var. A., . . . . .	174
Fig. 4B. „ „ „ var. B., . . . . .	174
Fig. 5. „ „ <i>rugosa</i> , n. sp., . . . . .	174
Fig. 6. „ „ <i>rubeola</i> , n. sp., . . . . .	175
Fig. 7. „ „ „ var., . . . . .	176
Fig. 8. „ „ <i>lævis</i> , n. sp., . . . . .	179
Fig. 9. „ „ <i>esperii</i> , n. sp., . . . . .	179
Fig. 10. „ „ <i>philippinensis</i> , n. sp., . . . . .	176
Fig. 10A. „ „ „ var., . . . . .	176
Fig. 10B. „ „ „ var., . . . . .	176

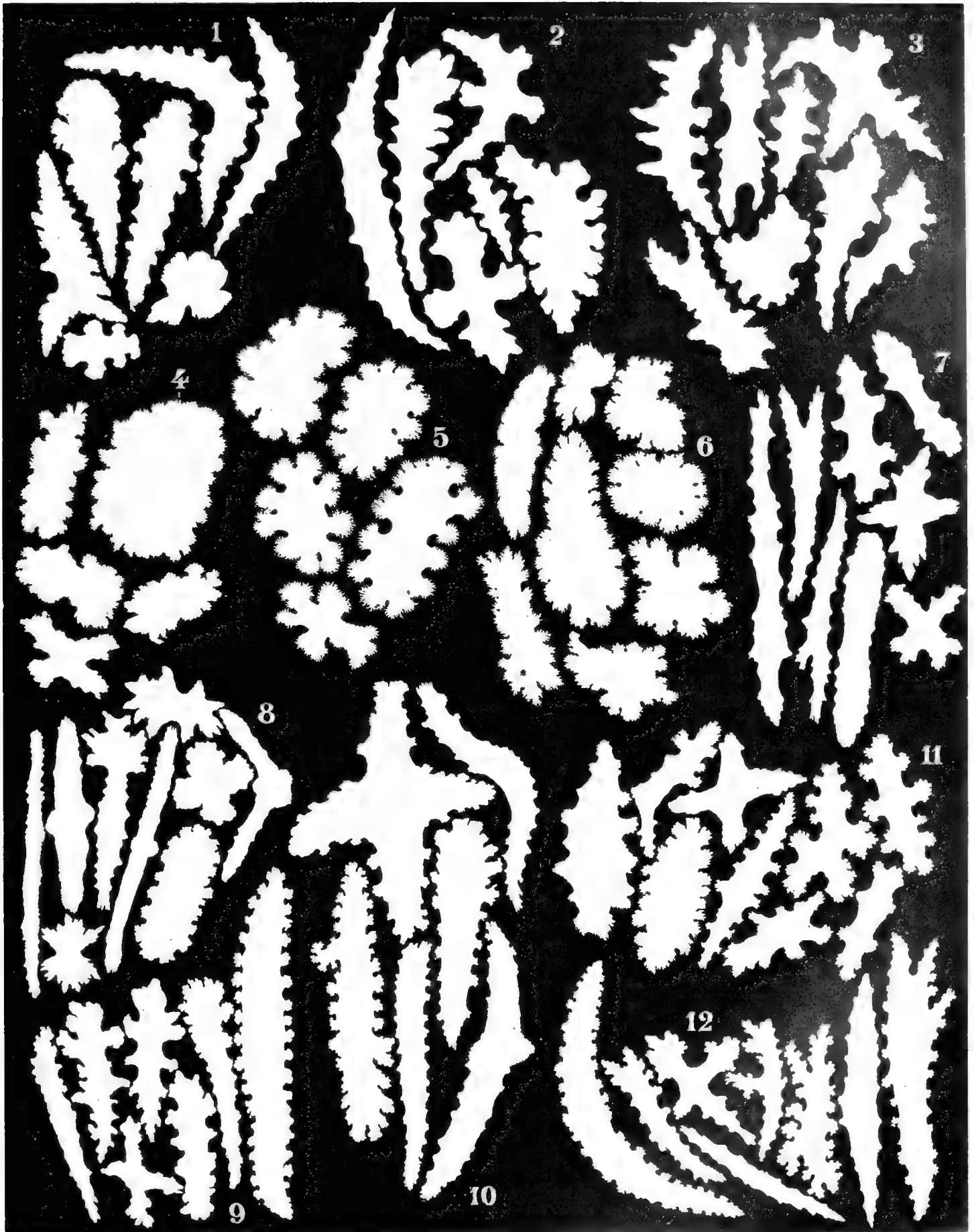


H. Ambruster, litt. del. et imp.

1 SUBERIA. 2 SUBEROGORGIA 3 KEROEIDES 4-10 MELITODES

# PLATE XLI.

	Page
Fig. 1. Spicules of <i>Melitodes sinuata</i> , n. sp., . . . . .	177
Fig. 2. „ „ „ <i>fragilis</i> , n. sp. . . . .	180
Fig. 3. „ „ „ <i>nodosa</i> , n. sp., . . . . .	178
Fig. 4. „ „ <i>Parisis fruticosa</i> , Verrill, . . . . .	182
Fig. 5. „ „ „ <i>australis</i> , n. sp., . . . . .	183
Fig. 6. „ „ „ <i>minor</i> , n. sp., . . . . .	184
Fig. 7. „ „ <i>Anthomastus canariensis</i> , n. sp., . . . . .	242
Fig. 8. „ „ „ <i>steenstrupi</i> , n. sp., . . . . .	243
Fig. 9. „ „ <i>Sarcophytum philippinensis</i> , n. sp., . . . . .	246
Fig. 10. „ „ „ <i>tongatabuensis</i> , n. sp., . . . . .	245
Fig. 11. „ „ „ <i>tracheliophorum</i> , Marenzeller, . . . . .	249
Fig. 12. „ „ „ <i>ambiguum</i> , n. sp., . . . . .	247

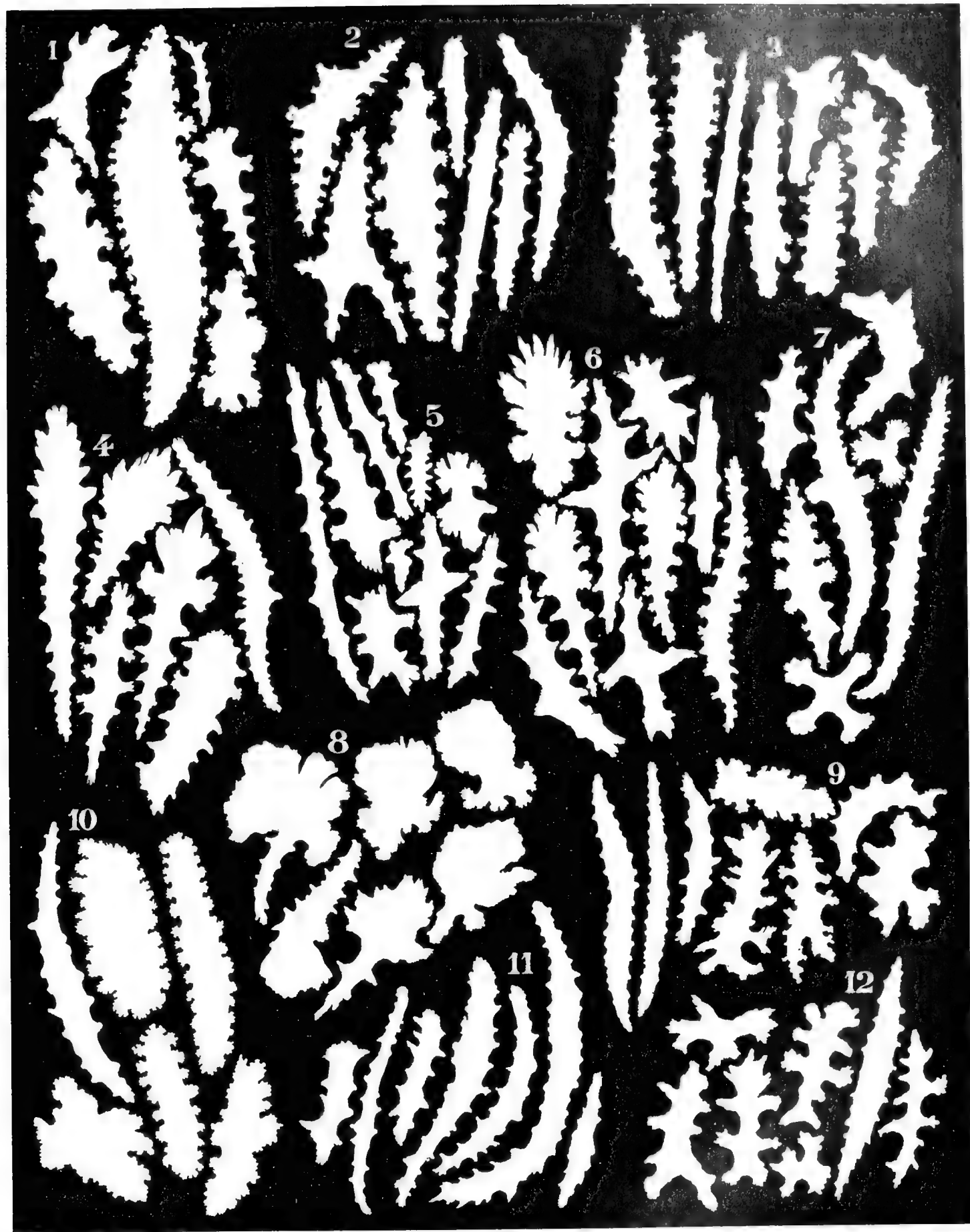


F. Arrhenius, Bern, 1891, 1892, 1893

1-3 MELITODES 4-6 PARISIS. 7-8 ANTHOMASTUS. 9-12 SARCOPHYTUM.

# PLATE XLII.

	Page
Fig. 1. Spicules of <i>Lobophytum marenzelleri</i> , n. sp., . . . .	251
Fig. 2. „ <i>Sarcophytum glaucum</i> , Quoy and Gaimard, . . . .	248
Fig. 3. „ „ <i>atlanticum</i> , n. sp., . . . .	245
Fig. 4. „ <i>Alcyonium sollasi</i> , n. sp., . . . .	240
Fig. 5. „ „ <i>antarcticum</i> , n. sp., . . . .	239
Fig. 6. „ „ <i>haddonii</i> , n. sp., . . . .	240
Fig. 7. „ <i>Bellonella bocagei</i> (Saville Kent), . . . .	241
Fig. 8. „ <i>Paranephthya capitulifera</i> , n. sp., . . . .	227
Fig. 9. „ <i>Telesto rigida</i> , n. sp., . . . .	261
Fig. 10. „ <i>Clavularia tubaria</i> , n. sp., . . . .	256
Fig. 11. „ „ <i>elongata</i> , n. sp., . . . .	257
Fig. 12. „ <i>Sympodium verrilli</i> , n. sp., . . . .	271



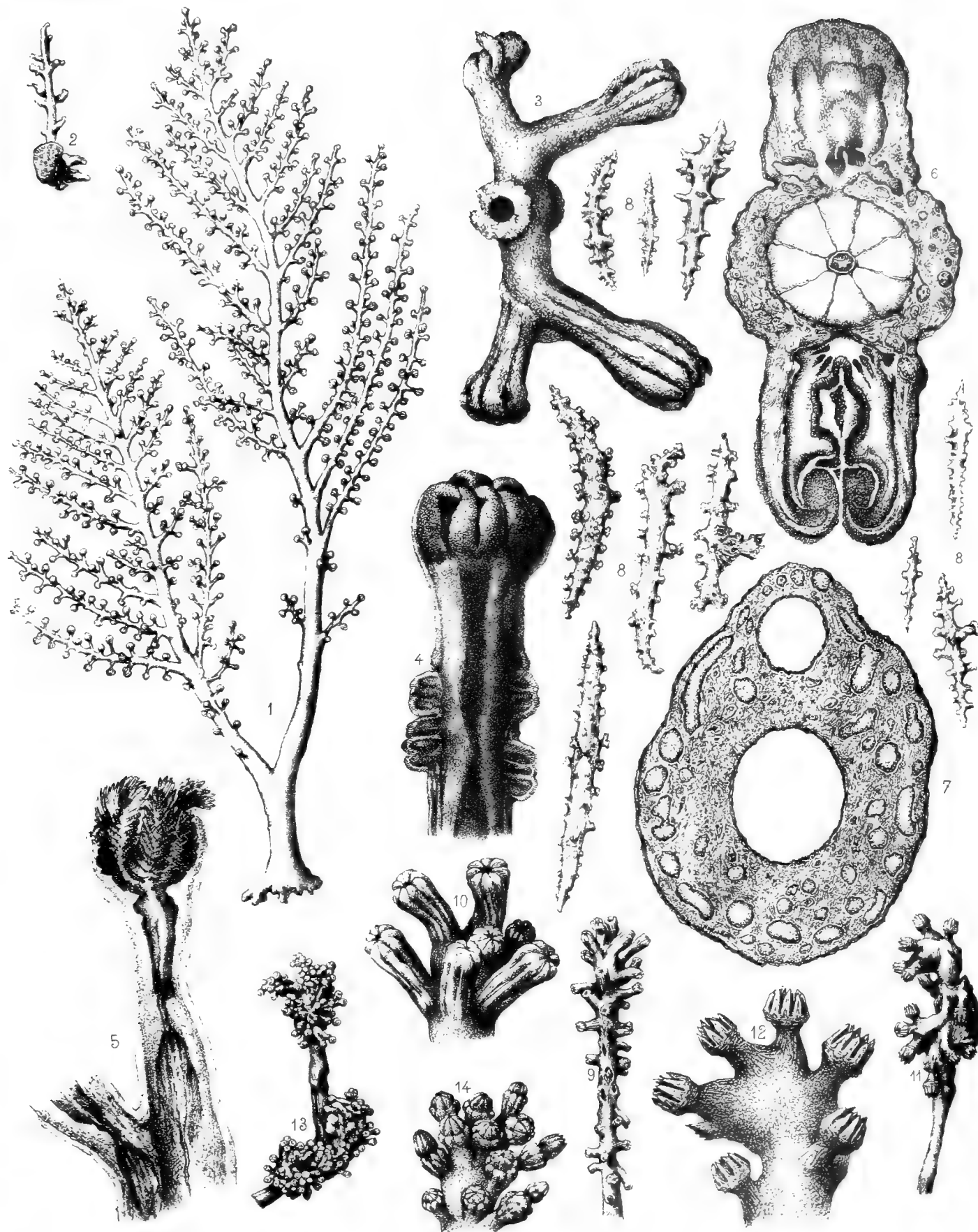
P. Armbruster, Bern, del. lith. et imp.

1 LOBOPHYTUM 2-4 SARCOPHYTUM 5-6 ALCYONIUM 7 BELONELLA  
8 PARANEPHTHYA 9 TELESTO. 10-11 CLAVULARIA. 12 SYMPODIUM

# PLATE XLIII.

Fig. 1.	<i>Cælogorgia palmosa</i> , Milne-Edwards.	Small colony ; natural size,	Page 266
Fig. 2.	„ „	Portion of young colony ; natural size.	
Fig. 3.	„ „	Polyps ; enlarged.	
Fig. 4.	„ „	An axial polyp ; with lateral buds.	
Fig. 5.	„ „	Longitudinal section of polyp.	
Fig. 6.	„ „	Cross section through axial polyp and buds.	
Fig. 7.	„ „	Cross section through axial polyp ; lower part.	
Fig. 8.	„ „	Spicules.	
Fig. 9.	<i>Clavularia cylindrica</i> , n. sp.	Colony ; natural size, . . . . .	258
Fig. 10.	„ „	Polyps ; enlarged.	
Fig. 11.	<i>Sympodium armatum</i> , n. sp.	Colony ; natural size, . . . . .	272
Fig. 12.	„ „	Polyps ; enlarged.	
Fig. 13.	„ „ <i>glomeratum</i> , n. sp.	Colony ; natural size, . . . . .	273
Fig. 14.	„ „	Polyps ; enlarged.	





R. Armbruster, Bern, del. lith et imp.

1-8 COELOGORGIA 9-10 CLAVULARIA 11-14 SYMPodium.



THE  
VOYAGE OF H.M.S. CHALLENGER.

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ZOOLOGY.

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REPORT on the PELAGIC FISHES collected by H.M.S. Challenger during the  
Years 1873–76. By Dr. ALBERT GÜNTHER, M.A., M.D., Ph.D., F.R.S.,  
Keeper of the Department of Zoology in the British Museum.

INTRODUCTION.

THE Third Report on the Fishes collected during the voyage of H.M.S. Challenger comprises an account of the specimens which were obtained in the open ocean by means of the surface-net or otherwise. It is devoted, therefore, chiefly to *Pelagic* Fishes.

The specimens were as numerous as those of either the shore or deep-sea series, but by far the greater majority were of small or even minute size. Many of them would have been lost but for the care taken at the time of their capture, by separating them in tubes or mounting them there and then for microscopic examination. There were comparatively few which, during or after capture, had so much suffered as to be unfit for examination or description; but I am compelled to omit in this Report mention of a considerable number of specimens which were obtained at such an early stage of their development, and which exhibit such small progress towards specialisation, that I am unable to arrive at any conclusion as to the family or even order of fishes to which they belong. On the other hand, I have admitted all such young forms, which, even if their origin be uncertain at present, may be readily recognised by future observers.

The pelagic fish-fauna consists, first, of the truly pelagic fishes, that is, fishes which inhabit the surface of the ocean, approaching the shore only accidentally or while in pursuit of their prey; the majority are bred in the open sea and pass through the various

stages of growth without coming into the vicinity of land. These truly pelagic fishes are represented in the Challenger collection by numerous genera: (species of) *Carcharias*,<sup>1</sup> *Xiphias* and *Histiophorus*, *Coryphæna*, *Lirus*, *Cubiceps*, *Psenes*, *Nomeus*, *Platystethus*, *Thynnus*, *Lepidothynnus*, *Echeneis*, *Seriolichthys*, *Antennarius*, *Centriscus*, *Scombrosox*, *Exocoetus*, *Scopelus* (sp.), *Diplophos*, *Astronesthes*, *Halaphya*, (*Leptocephalus*).

The number of these surface fishes is considerably increased by others which for the greater part of their life inhabit the depth of the ocean, from 100 fathoms downwards. The causes which make these fishes ascend to the surface are not known; but as some of them have been observed to make their appearance at the surface periodically, we may surmise that this change of habitat is in connexion with their propagation. Indeed, most of them are found at the surface only during the early stages of their growth, and it would seem that their ova and fry require for development and growth the higher temperature and the light of the surface water. These fishes connect the surface pelagic fauna with the deep-sea fauna, and are represented in the Challenger collection by the following genera:—*Scorpena* (*dactyloptera*, young), *Nealotus* (young), *Lepidopus* (adult and young), *Thyrmites* (young), *Schedophilus* (young), *Centrolophus* (young), *Trachipterus* (young), *Lophotes* (young), *Onus* sp. (young), *Bregmaceros* (adult and young), undetermined genera of *Pleuronectidæ*, *Scopelus* sp. (adult and young), *Prymnothonus*.

The pelagic fauna receives likewise a very considerable contingent from the littoral fauna. A great number of young and undeveloped fishes, which are the offspring of species rarely found in the adult state at any distance from land, occur at the surface in the open sea. Their presence under conditions so widely different from those under which they live when mature, can be explained by the fact that spawn or fry floating on the surface may be driven by currents to great distances from the place where the spawn was originally deposited; this must frequently happen, especially on oceanic banks which are covered by a small depth of water, and which, therefore, are suitable localities for littoral species. The wide distribution of the same littoral species over large oceanic areas, like that of the Tropical Indo-Pacific, finds thus an easy explanation. The Challenger obtained many immature specimens of such littoral forms in the open sea, as *Pimelepterus*, *Holocentrum*, *Lichia*, *Platystethus huttonii*, *Trigla*, *Brosmius* (?), *Onus* sp. *Fierasfer*, *Solea* (?), *Synaptura* (?), *Hemirhamphus*, *Belone*, *Balistes*, *Tetrodon*.<sup>2</sup>

Finally, fully developed specimens of littoral species may also stray or be accidentally driven into the open sea. But these fishes must be considered to be occasional stragglers

<sup>1</sup> Very little is known about the propagation of the pelagic species of *Carcharias*; all seem to be viviparous, bringing forth their young in the open sea, like other viviparous Plagiostomes, or on oceanic banks.

<sup>2</sup> Whether *Branchiostoma* should be included in this list is uncertain at present.

and strangers to the pelagic fauna. The Challenger collection contains several instances of such irregular occurrences, viz., *Hemerocoetes*, *Gobius*, *Fundulus*, *Muræna*.

Thus, the pelagic fauna comprises a very varied assemblage of forms : not only fishes excelling above all others in the power of swimming with regard to rapidity as well as endurance of motion, but also species in which the power of locomotion is almost reduced to the faculty of floating on the surface, without resistance, at the mercy of wind and current, or of retaining their hold on other floating substances, like sea weed, logs of wood, &c. It comprises fishes which can raise themselves out of the water in short flights, and others which are provided with a special apparatus to attach themselves to a rapid swimmer, thus partaking of all the advantages derived from his power of locomotion. Many accompany ships, large fishes, Medusæ, any floating object, partly as commensals, partly for protection. All are carnivorous. They seem to descend during very stormy weather to a depth to which the violence of the surface agitation does not reach. And certainly all nocturnal forms pass the day at some depth, coming to the surface during the night only ; they are provided with luminous organs like many bathybial forms, and, indeed, form a transition to the deep-sea fauna.

# SYSTEMATIC INDEX.

	PAGE		PAGE
I. SHARKS—		III. ANACANTHS—continued.	
<i>Carcharias glaucus</i> , L., . . . . .	5	<i>Auchenoceros punctatus</i> , Hutton, . . . . .	26
<i>lamia</i> , Risso, . . . . .	5	<i>Auchenoceros</i> sp. ? . . . . .	27
<i>obscurus</i> , Les., . . . . .	5	<i>Fierasfer acus</i> , Brünn., . . . . .	27
II. ACANTHOPTERYGIANS—		PLEURONECTIDÆ, . . . . .	28
<i>Pimelopterus waigiensis</i> , Q. and G., . . . . .	5	IV. PHYSOSTOMI—	
<i>fuscus</i> , Lac., . . . . .	6	<i>Scopelus</i> , Gthr., . . . . .	30
<i>Scorpena dactyloptera</i> , de la R., . . . . .	6	<i>caninianus</i> , Mus. Brit., . . . . .	30
<i>Holocentrum</i> sp., . . . . .	6	<i>coccoi</i> , Cocco, . . . . .	30
<i>Xiphias gladius</i> , L., . . . . .	6	<i>nigroocellatus</i> , Gthr., . . . . .	30
<i>Histiophorus</i> sp., . . . . .	6	<i>scoticus</i> , n. sp., . . . . .	31
<i>Nealotus tripes</i> , Johns., . . . . .	6	<i>Diplophos</i> , Gthr., . . . . .	32
<i>Lepidopus tenuis</i> , Gthr., . . . . .	7	<i>tænia</i> , Gthr., . . . . .	32
<i>Thyrscites prometheus</i> , C. V., . . . . .	7	<i>pacificus</i> , n. sp., . . . . .	33
<i>Seriolichthys bipinnulatus</i> , Q. G., . . . . .	8	<i>Fundulus nigrofasciatus</i> , Lesueur, . . . . .	33
<i>Lichia glauca</i> , L., . . . . .	9	<i>Ovum of Scombresocid</i> , . . . . .	34
<i>vadigo</i> , Risso, . . . . .	9	<i>Hemirhamphus</i> sp., . . . . .	34
<i>Coryphæna</i> , Artedi, . . . . .	9	<i>Scombresox</i> , . . . . .	34
<i>Lirus</i> , Lowe, . . . . .	10	<i>Belone</i> sp., . . . . .	34
<i>porosus</i> , Rich., . . . . .	11	<i>Exocoetus</i> , L., . . . . .	35
<i>paucidens</i> , n. sp., . . . . .	11	<i>obtusirostris</i> , Gthr., . . . . .	35
<i>Cubiceps gracilis</i> , Lowe, . . . . .	11	<i>spilurus</i> , Gthr., . . . . .	35
<i>Psenes cyanophrys</i> , Cuv., . . . . .	12	<i>solandri</i> , C. V., . . . . .	35
<i>arafurensis</i> , n. sp., . . . . .	13	<i>naresii</i> , n. sp., . . . . .	36
<i>Nonnus gronovii</i> , Gm., . . . . .	13	<i>affinis</i> , Gthr., . . . . .	37
<i>Platystethus huttonii</i> , Gthr., . . . . .	13	<i>rondeletii</i> , C. V., . . . . .	37
<i>Lepidothynnus</i> , n. gen., . . . . .	15	<i>simus</i> , C. V., . . . . .	37
<i>huttoni</i> , n. sp., . . . . .	15	<i>Astronesthes niger</i> , Rich., . . . . .	38
<i>Thynnus thunnina</i> , C. V., . . . . .	17	<i>Halaphya</i> , n. gen., . . . . .	38
<i>Echeneis remora</i> , L., . . . . .	18	<i>elongata</i> , n. sp., . . . . .	39
<i>naucrates</i> , L., . . . . .	18	<i>Prymnothonus</i> , Rich., . . . . .	39
<i>albescens</i> , Schleg., . . . . .	18	<i>Muræna</i> sp., . . . . .	42
<i>Hemerocoetes acanthorhynchus</i> , Forst., . . . . .	18	<i>Leptocephalus</i> , Gron., . . . . .	42
<i>Antennarius marmoratus</i> , Gthr., . . . . .	18	V. PLECTOGNATHS—	
<i>Trigla macrodactylus</i> , n. sp., . . . . .	18	<i>Balistes</i> sp., . . . . .	42
<i>Gobius</i> sp., . . . . .	19	<i>Tetrodon</i> sp., . . . . .	42
<i>Centriscus scolopax</i> , L., . . . . .	19	VI. LEPTOCARDII—	
<i>Lophotes cepedianus</i> , Giorna, . . . . .	19	<i>Branchiostoma</i> , Costa, . . . . .	42
III. ANACANTHS—		<i>pelagicum</i> , n. sp., . . . . .	43
<i>Onus reinhardtii</i> , Collett, . . . . .	20		
<i>Raniceps trifurcus</i> , Walb., . . . . .	21		
<i>Bregmaceros</i> , Thompson, . . . . .	22, 24		
<i>Bregmaceros maclellandii</i> , Thompson, . . . . .	25		
<i>Auchenoceros</i> , Gthr., . . . . .	24		

## DESCRIPTION OF SPECIES.

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### I. SHARKS.

Of pelagic Sharks, that is, of species which were found at a considerable distance from land, and are known to have a wide geographical range, only a few specimens were preserved. They belong to three well-known species of the genus *Carcharias*.

#### *Carcharias glaucus*, L.

A specimen, 10 feet long, was caught on March 2, 1876, in the South Atlantic, and another, 8 feet long, on April 5, 1875, off Japan. The Blue Shark is known to inhabit the seas of the temperate and tropical zones generally, but I believe that this is the first recorded instance of its occurrence in Japanese waters.

#### *Carcharias lamia*, Risso.

One specimen, 7 feet long, was caught near the Kermadec Group. This also seems to be the first recorded instance of the occurrence of this Shark in the Indo-Pacific.

#### *Carcharias obscurus*, Les.

A specimen, 47 inches long, was caught off the coast of Sierra Leone on April 9, 1876. A second specimen, obtained near the island of Ascension, was included in the Report on the Shore Fishes (Zool. Chall. Exp., pt. iv. p. 5).

### II. ACANTHOPTERYGIANS.

#### *Pimelepterus waigiensis*, Quoy and Gaimard.

Two specimens of 20 and 22 mm. in length were taken from driftwood, north of Papua, February 21, 1875, and resemble more mature ones in every respect, so that no change with advancing age seems to take place in this genus. The teeth are still hidden below the mucous membrane.

*Pimelepterus fuscus*, Lacép.

A single very young specimen, 27 mm. long, was captured south of the Cape of Good Hope, in lat.  $35^{\circ} 4' S.$ , long.  $18^{\circ} 37' E.$ , near the surface; it has entirely the aspect of the mature fish, but the teeth are not yet developed. This species was previously known to occur at the Cape of Good Hope.

*Scorpæna dactyloptera*, de la Roche.

Two specimens, 5 and 9 mm. long, were obtained on April 26, 1876, off St. Vincent, Cape Verde Islands. As regards general shape, these young fishes do not differ from the adult, but the spines on the occiput and præoperculum are comparatively much larger and finely denticulated. The pectoral fin also is considerably longer, extending in the smaller specimen almost to the root of the caudal fin. Also the spines of this specimen are longer than in the other.

*Holocentrum* sp.

A specimen, 6 mm. long, obtained in April 1875, between the Admiralty Islands and Japan, represents the stage figured by Lütken, Vid. Selsk. Skr., xii. 1880, tab. 2, fig. 6. Like the specimen figured there, it possesses the enormously elongate nuchal and præopercular spines, but the rostral process is shorter.

*Xiphias gladius*, L.

A specimen,  $1\frac{1}{2}$  inches long, obtained at the surface between Tenerife and St. Thomas, West Indies, is not in a good condition, and represents the stage figured by Lütken, Vid. Selsk. Skr., xii. 1880, tab. 2, fig. 10.

*Histiophorus* sp.

A specimen, 9 mm. long, caught in the surface-net between the Admiralty Islands and Japan, in April 1875, agrees in all particulars with the one which I figured and described in Journ. Mus. Godeffroy, vol. i., 1873, p. 98.

*Nealotus tripes*, Johns.

The specimen, which was captured at Station 40, in lat.  $34^{\circ} 51' N.$ , long.  $68^{\circ} 30' W.$ , and which is only 33 mm. long, has been fully referred to in the Report on the Deep-



Sea Fishes (Zool. Chall. Exp., pt. lvii. p. 35). I have there stated the reasons which lead me to believe that it was captured near the surface, and not at the depth of 2675 fathoms to which the dredge descended on that occasion.

*Lepidopus tenuis*, Gthr.

*Lepidopus tenuis*, Günth., Zool. Chall. Exp., pt. lvii. p. 37, pl. vii. fig. B.

On the passage from the Sandwich Islands to Tahiti, at Station 271, in lat.  $0^{\circ} 33' S.$ , long.  $151^{\circ} 34' W.$ , a young Trichiurid, 95 mm. long, was obtained. The trawl had been at a depth of 2425 fathoms, but it is probable that this small and delicate fish was swimming near to the surface when it got entangled by the trawl. Although there cannot be any doubt as to this specimen being a young *Lepidopus*, it is too much injured to enable us to say whether it should be referred to *Lepidopus tenuis* or *Lepidopus elongatus*, if, indeed, these fishes are specifically distinct. Neither is the place of its capture a guide for its specific determination, *Lepidopus tenuis* having been found in the Japanese Sea, and *Lepidopus elongatus* off New Zealand and in the North-Western Atlantic.

*Thyrsites prometheus*, C. V. (Pl. I. figs. C, D).

Of the two small fishes here described and figured, the smaller, which is 5 mm. long, was obtained on June 17, 1875, south of Yeddo, and the larger, of double the size, five weeks later, namely on July 23, 1875, north of the Sandwich Islands.

The specimens are not in a good condition, having been placed at the time of their capture on a microscopic glass-slide; the sides of the head have been much crushed, so as to render the outlines of its constituent parts indistinct, more especially the opercular and scapular portions, which, therefore, could not be delineated in the figures.

The specimens are evidently not far removed from the embryonic condition; and Lütken's excellent account<sup>1</sup> of the developmental stages of *Nealotus* and *Gempylus* cannot leave us long in doubt as to the family of fishes to which our specimens should be referred, especially not, if, as I am still inclined to think, the caudalless and caudate Trichiuridæ be retained in the same family. The embryonic stage of the individuals is apparent from the pointed diphyrcercal termination of the vertebral column which is surrounded by a circular membrane out of which the caudal fin is developed; in both specimens the caudal rays are visible as extremely fine striæ. In the larger specimen (fig. C) a series of seven or eight hæmal apophyses has been developed in this portion of

<sup>1</sup> K. dansk. Vidensk. Selsk. Skriv., xii., 1880, p. 448 et seq.

the spinal column; they are scarcely indicated in the smaller one (fig. D). An upper and lower membranous fold, bordering the upper and lower sides of the tail, represents the soft dorsal and anal. In both specimens the greater portion of the fold is striated, the rays being thus faintly indicated. In the larger specimen this fold is separated from the caudal fin and spinous dorsal by a distinct notch.

The spinous dorsal is extremely high, more so in the larger specimen than in the smaller one. It is composed of twenty simple spines, of which the six anterior are armed with numerous barbs; the barbs of the foremost spine point upwards and those of the following downwards. In the young specimen only the first spine shows the denticulation, and there are two very distinct black pigment-spots on the membrane connecting the anterior spines, which are missing in the larger example.

Only in the larger example a trace of pectorals is to be seen; the ventral consists of a strong barbed spine, very long in the older example, shorter in the younger, in which, besides, three soft rays may be distinctly seen.

Spines and excrescences of the bones of the head can be seen especially in the larger example, but they are too indistinct to be exactly described, with the exception of a few short ones at the extremity of the snout and two slender spines on the præopercular margin.

*Seriolichthys bipinnulatus*, Q. G., young (Pl. I. figs. E, F).

The specimens, which I consider to be the young of this fish, were obtained in considerable numbers from driftwood, north of New Guinea, on February 21, 1875. They measure from  $\frac{1}{2}$  to 1 inch in length, and are in a perfect state of preservation.

The changes which this genus undergoes with age are somewhat less considerable than in the allied *Seriola*. As usual in young fishes the body is shorter and deeper than in those approaching the mature age, and in those of half an inch in length it is still shorter than in those of double the size. Also the head and the eye are comparatively larger. The fins are perfectly developed, showing the normal number of rays, viz., D. 5-6 | 27. A. 19. However, as in the young of other genera, in which the adult form possesses detached finlets, so here these rays are not yet differentiated from the remainder of the fin; and I may remark on this occasion that in the specimens of *Seriolichthys* which have attained to a length of 4 inches, these finlets are sometimes still connected by a delicate membrane to the preceding ray.

In the smallest examples the angle of the præoperculum is armed with two prominent spines, the remaining margin being simply denticulated. This armature has entirely disappeared in specimens of 1 inch in length.

Scales begin to be visible in the larger specimens. The coloration is uniform, without any of those blackish bands or markings by which young *Seriola* are distinguished.

(?) *Lichia glauca*, L., young (Pl. I. fig. G).

The fish believed to be the young of this species was obtained with the surface-net on April 13, 1876, off the west coast of Africa, in lat.  $10^{\circ} 55' N.$ , long.  $17^{\circ} 46' W.$ , and is only 10 mm. long.

The accompanying figure will give a sufficient idea of the general form of its body, which is scaleless and of a silvery colour. The spinous dorsal only is marked with a very conspicuous deep black blotch. The præoperculum is armed with a long spine at the angle, and with several smaller ones besides, which are much more conspicuous on the lower limb than on the posterior. Formula of the fins : D.  $\frac{6}{26}$ . A.  $\frac{3}{22}$ . The fin-spines are strong ; those of the dorsal as high as, and continuous with, the rays ; the third and fourth of these spines are the longest. Caudal slightly emarginate.

It was not without some hesitation that I ventured to refer this single young specimen to *Lichia glauca*, without being able to prove the correctness of this view by intermediate stages. However, I know of no other fish of this part of the Atlantic except *Trachynotus goreensis* (= *Trachynotus myrias*) with which it might be associated ; the general form of the head and body, and especially the numbers of the fin-rays, point rather to *Lichia glauca* than to *Trachynotus*, whilst the fins, in the form of which our young fish so conspicuously differs from that of matured fish, are just those organs which we should expect to be modified with age.<sup>1</sup>

#### *Coryphæna*, Artedi.

The young stages of *Coryphæna* have been known for some time (see, for instance, *Fische der Südsee*, p. 146), but we owe to Dr. Lütken<sup>2</sup> our acquaintance with the means of discriminating between the young of *Coryphæna hippurus* and *Coryphæna equisetis* (*loc. cit.*, p. 489). Yet, even with the help of the excellent figures which he has given of the young of both species (*loc. cit.*, pl. iii. figs. 9–13) the specific determination is often very difficult and uncertain, especially of individuals less than  $1\frac{1}{2}$  inches long. Of the three specimens collected by the Challenger I refer two to *Coryphæna hippurus*, viz., one of  $1\frac{1}{4}$  inches obtained in the North Atlantic on April 28, 1876, and one  $\frac{3}{4}$  inch long from the vicinity of the Low Archipelago, September 16, 1875 ; and the third to *Coryphæna equisetis* ; it is 1 inch long, and was taken in the North Atlantic on April 29, 1876.

<sup>1</sup> The recent discovery off the island of Skye of a specimen of *Lichia vadigo* is additional evidence of the pelagic habits of the fishes of this genus.

<sup>2</sup> Dr Lütken (*loc. cit.*, p. 483) draws on this occasion attention to the fact that the undue creation of nominal species of this genus is the work of Valenciennes, and not of Cuvier, to whom I had attributed it in *Catal. Fish.*, vol. ii. p. 405. This is perfectly true, and I regret so far the oversight on my part, which I might have avoided by a more careful examination of the index of vol. ix. of the *Hist. nat. des Poissons*. However, the fact of Cuvier's tendency of multiplying species, especially towards the end of his life, is, nevertheless, undeniable ; witness his treatment of the genera *Elacate*, *Trachynotus*, &c. I fully agree with Dr. Lütken's conclusion that there are in existence probably two species of Dolphins only.

*Lirus*, Lowe.

*Leirus*, Lowe, Trans. Phil. Soc. Cambridge, vi., 1836, p. 199.

„ Jordan and Gilbert, Synopsis, 1882, p. 452.

*Palinurus*, De Kay, N. York Faun. Fish., 1842, p. 118.

*Hyperoglyphe*, Günth., Fish., i., 1859, p. 337.

„ Lütken, K. dansk. Vidensk. Selsk. Skriv., xii., 1880, pp. 521, 602.

*Pammelas*, Günth., Fish., ii., 1860, p. 485.

*Palinurichthys*, Gill, Proc. Acad. Nat. Sci. Philad., 1861, p. 20.

On the British Museum coming into possession of a specimen of the Rudder-fish, *Pammelas perciformis*, I was enabled to recognise the generic identity of that species with the Australian *Hyperoglyphe porosa*. In the meantime Messrs. Jordan and Gilbert pointed out the true relationship of the Rudder-fish, viz., that it was closely allied to *Centrolophus bennettii* from Madeira, for which Lowe had already proposed the generic name of *Leirus*. *Hyperoglyphe* forms merely the extreme link of a chain of modifications of the form and structure of the dorsal fin as observed, in its most generalised form, in *Centrolophus pompilus* or *Schedophilus medusophagus*. In these fishes the dorsal fin is composed of extremely numerous, homogeneous soft rays, of which the anterior only are unarticulated, though flexible.

In other species of the same genera these unarticulated rays become stiffer and more or less spinous, and as they become stronger and more differentiated, the number of soft rays decreases. In *Lirus perciformis* the spinous and soft portions are completely differentiated, although they still form one continuous fin. In *Lirus porosus* (as I now call the Australian species) a separation into two fins is indicated, but not fully accomplished. But all these fishes form one natural group, the members of which possess the complicated pharyngeal dentary apparatus. *Hyperoglyphe*, therefore, should be eliminated from the Perch-like fishes, and placed as a synonym of *Lirus* immediately after *Schedophilus*. Its teeth are minute, in a single series, and not villiform or in a band.

*Lirus*, like *Schedophilus* and *Centrophilus*, is a truly pelagic form. These fishes follow floating objects or slowly moving animals (Medusæ),<sup>1</sup> either for the purpose of obtaining protection, or for the sake of food, as many small animals, like Crustaceans, are attracted to the same objects. Some, at least, of the species live at considerable depths, as we may gather from the testimony of fishermen, and safely conclude from the softness of their skeletons; and, probably, the young of all live at or near the surface.

<sup>1</sup> The large Medusæ on our coast (*Pilema octopus*) are almost always accompanied by young fishes. On the south coast I found them to be Horse-mackerel, one large Medusa offering a temporary home to more than fifty of these young fishes, which were from 2 to 3 inches long. Only once I found another species of fish among them, viz., a young Whiting.

*Lirus porosus*, Richards (Pl. II. fig. F).

*Diagramma porosa*, Richards, Ereb. and Terr. Fish., p. 26, figs. 5, 6.

*Hyperoglyphe porosa*, Günth., *loc. cit.*

Since the first discovery of this species during the voyage of the "Erebus" and "Terror," no other specimen seems to have fallen into the hands of a naturalist. During the present voyage seven young examples, 25 to 30 mm. long, were obtained from a patch of floating sea-weed near the Kermadec Islands, Station 170. The hind margin of the præoperculum is finely and evenly serrated, the angle and lower margin of the bone being armed with coarser and longer teeth. Pale olive; fins blackish, with the exception of the caudal fin which is whitish.

*Lirus paucidens*, n. sp. (Pl. II. fig. E).

D.  $2\frac{7}{5}$ . A.  $1\frac{3}{9}$ .

This species, of which I have only three very young specimens, is closely allied to *Lirus porosus*, but the armature of the præoperculum is very different; some of the characters here mentioned may apply to the young stage only.

The height of the body is contained  $2\frac{1}{3}$  times in the total length (without caudal), the length of the head  $2\frac{1}{2}$  times. Eye about one-third of the length of the head, the maxillary not extending to below the middle of the eye. The entire margin of the præoperculum armed with distant and comparatively strong dentations. The soft dorsal and anal fins rather high, higher than the spinous dorsal, which is continuous with the soft; pectoral fins extending beyond, ventrals to, the anal. Dark-brown, pectoral and caudal fins white.

Three specimens, the largest of which is 35 mm. long, were obtained in the surface-net on the passage from New Guinea to Japan.

*Cubiceps gracilis*, Lowe (Pl. II. figs. A, B, C).

A single specimen, 3 inches long, was obtained in the surface-net on the passage between Tenerife and St. Thomas, West Indies. It proves that this species does not undergo great changes during growth, and that the fish described and figured by Lütken (*op. cit.*) under the name of *Psenes maculatus* is not the young of the present species.

Adult *Cubiceps* must be extremely rare; no other specimen has occurred, beside the one obtained by Sir A. Smith, so that the question of the specific distinctness of *Cubiceps capensis* and *Cubiceps gracilis* is still a matter of uncertainty.

Young specimens of *Cubiceps gracilis* are comparatively much more common. The British Museum has received, since the publication of the Catalogue, two examples, 7 and  $8\frac{1}{2}$  inches long, obtained at Madeira by Mr. J. T. Johnson; six of from  $1\frac{1}{4}$  to  $2\frac{1}{2}$  inches in length, purchased by a friend of the writer at Messina; and, finally, two of 2 and  $2\frac{1}{2}$  inches in length, taken by the late Commander W. E. Cookson, near the Azores with Medusæ.

All these specimens resemble much the adult state, so that there could not have been any difficulty in recognising the species. None of the specimens show the slightest trace of spots. The younger ones are comparatively shorter in the body, have a more elevated dorsal fin, and shorter pectorals. We figure, of the natural size, a specimen from Madeira (fig. A'), one from the Azores (fig. B), and the youngest from Messina (fig. C).

*Psenes cyanophrys*, C. V.

*Psenes cyanophrys*, Cuv. Val., ix. p. 260, pl. cclxv.; Lütken, K. dansk. Vidensk. Selsk. Skriv., 1880, p. 517.

„ *javanicus*, Cuv. Val., ix. p. 264; Günth., Fish., ii. p. 494.

„ *leucurus*, Cuv. Val., ix. p. 265; Jenyns, Zool. Beagle, Fish, p. 73; Günth., Fish., vol. ii. p. 495.<sup>1</sup>

? „ *auratus*, Cuv. Val., ix. p. 264.

*Cubiceps multiradiatus*, Günth., Proc. Zool. Soc. Lond., 1871, p. 661, pl. lxi.

An examination of a long series of examples shows that the various terms mentioned above refer to one species only, which is truly pelagic and distributed over the Tropical Atlantic, as well as the Indian Ocean. Very young specimens have invariably a white caudal fin. The number of the anal rays ranges from twenty-five to thirty.

The following specimens were collected:—

- a. 10 lines long. Between Tenerife and St. Thomas.
- b. 10 lines long. From Gulf-weed, south of Bermuda; April 1873.
- c. 3 inches long. South of New Guinea; tow-net; August 29, 1874.
- d-e. 1-2 inches long. South of Philippines; surface-net; February 8, 1875.
- f-h. 1-2 inches long. Between Philippines and Papua; surface-net; February 10, 1875.
- i-z.  $\frac{2}{3}$ - $2\frac{1}{2}$  inches long. North of Papua; from driftwood; February 21, 1875.
  - a. 10 lines long. North of Papua; tow-net; March 3, 1875.
  - β.  $1\frac{1}{2}$  inches long. North of Papua; tow-net; March 13, 1875.
  - γ. 2 inches long. Between Papua and Japan; surface-net; 1875.

<sup>1</sup> Lütken (*loc. cit.*) distinguishes a *Psenes leucurus* from *Psenes cyanophrys*.

*Psenes arafurensis*, n. sp. (Pl. II. fig. G).

D. 7 | 20. A.  $\frac{3}{2}$ . L. lat. 47.

The height of the body is contained once and two-thirds in the total length without caudal; the length of the head twice and two-thirds. Snout truncated, short, much shorter than the eye, the diameter of which is two-fifths of the length of the head, and less than the width of the interorbital space. Lower margin of the præoperculum crescent-shaped. Cheek entirely scaly. Anterior dorsal rather higher than the second. Pectoral broad, as long as the head without snout and as the ventrals, which extend beyond the origin of the anal fin. Silvery; tail with some obscure cross-bands which extend over, and are more distinct on, the anal fin. Ventrals black in their basal and terminal thirds.

One specimen,  $1\frac{1}{2}$  inches long, was obtained in the Arafura Sea, with the surface-net September 23, 1874.

This specimen is evidently the young of a species attaining to a larger size.

*Nomeus gronovii*, Gm

This is a common pelagic fish between the Tropics, young specimens being found in almost all surface gatherings. The four specimens brought home by the Challenger were obtained accompanying Physalias, in the vicinity of the Low Archipelago, on September 16, 1875. They are from  $\frac{1}{2}$  to  $1\frac{1}{2}$  inches long.

*Platystethus huttonii*, Gthr. (Pl. II. figs. H, I).

*Platystethus huttonii*, Günth., Ann. and Mag. Nat. Hist., 1876, vol. xvii. p. 395.

D. 13-15 | 36. A.  $\frac{3}{2}$ . L. lat. 90.

Body much compressed, its height being one-third, the length of the head one-fourth, of the total (without caudal). Eye of moderate size, two-ninths of the length of the head, situated a little before the middle of the head, not far below the upper profile. Præorbital at least as wide as the eye. Mouth oblique, with the lower jaw very prominent, very narrow, the maxillary not extending to the front margin of the eye. Dorsal spines feeble, of moderate length; the soft dorsal and anal low. Anal spines short, but stronger than those of the dorsal fin. Pectoral broad, rounded, half the length of the head. Ventrals small. Caudal deeply forked. Silvery; back above the lateral line greenish; the spinous dorsal black.

This species was described from two specimens,  $6\frac{1}{2}$  inches long, sent by Professor Hutton, from Dunedin, New Zealand. It is admitted here in the series of pelagic

fishes, because it has helped me to clear up the nature of certain young fishes, of which I have known since the year 1860, without knowing to what genus they should be referred. That these young fishes are pelagic is amply proved by the three specimens in the British Museum, all of which were caught in the open sea.

1. The largest specimen is 26 mm. long, and was obtained in the tow-net on the passage from Australia to the Cape of Good Hope, by J. B. Godfrey, Esq., who however omitted to note the exact locality where it was captured. This is the specimen which I mentioned in the year 1860 in the Catalogue of Fishes, vol. ii. p. 415, as possibly representing the young stage of *Mene maculata*.

2. A small specimen, 18 mm. long, was obtained by the Challenger Expedition in July 1874, on the passage from Sydney to Wellington.

3. Finally, for the third specimen, which is only 15 mm. long, we are indebted to Mr. Wykeman Perry, who collected so many valuable specimens, whilst serving on board H.M.S. "Pearl," under the late Commodore Goodenough. This specimen was obtained in lat. 34° S., long. 12° E., in August 1873, that is, in the neighbourhood of the Cape of Good Hope.

The general form of these fishes may be best seen from the accompanying figure. They are characterised by their extremely compressed body, the chest and the abdomen forming a prominent sharp edge. The body is covered by a thick layer of silvery pigment, the largest specimen besides showing distinct cycloid scales; the lateral line runs parallel to the profile of the back, which is much less curved than the lower outline of the body. The back is occupied by a long dorsal fin, the anterior portion of which is spinous. The anal fin is also long, preceded by three spines; the ventral fins small, rudimentary, inserted at a considerable distance behind the root of the pectoral and likewise at a similar distance from the vent.

The head is of moderate size without any armature; eye of moderate size, the mouth small and obliquely turned upwards.

Although I have no doubt that these specimens are the young of *Platystethus*, I consider it quite possible that the three specimens belong to as many distinct species on account of the difference in the numbers of the fin rays. On the other hand we have to take into consideration, that owing to the very young age of these specimens, the posterior fin rays may still be undeveloped. In the largest of these young specimens, which is figured, the dorsal fin is composed of eighteen<sup>1</sup> spines and twenty-nine soft rays. The anal is armed with three spines of which the third is very short, as is also the case in the two other specimens; of soft rays I count eleven. I found it impossible to ascertain the number of dorsal spines in the two smaller specimens, without lacerating them in a manner which would have impaired their utility in the future, but the soft rays were

<sup>1</sup> A comparison with the specimens more recently acquired has shown me that a number of the rays in the dorsal and anal fins, which I formerly in the largest specimen considered to be soft, are in reality spinous.



found to be twenty-eight in the middle-sized specimens, whilst seventeen only could be counted in the smallest. A similar diversity obtains in the number of anal rays which is respectively fourteen and nine.

*Lepidothynnus*, n. gen.

For the knowledge of this fish I am indebted to Professor Hutton of Canterbury College, Christchurch. The specimen,  $5\frac{1}{2}$  feet long, was driven on shore in Lyttelton Harbour on April 17, 1887. It had the appearance of a Tunny, but was covered with scales. Of these Professor Hutton fortunately preserved some, and he also made a sketch of the fish which is reproduced on Pl. VI. fig. A. The specimen is preserved in Christchurch Museum as a skeleton, of which Professor Hutton kindly sent a photograph to me (Pl. VI. fig. A'). These materials, as well as some notes taken by my correspondent from the fresh fish, offer sufficient evidence that this form represents an undescribed genus of Scombroid fishes showing distinct affinities to *Gastrochisma*. It may be characterised thus :—

Body oblong, compressed, covered all over with large cycloid scales. Head with the upper profile arched, parabolic, compressed above into a ridge. Cleft of the mouth of moderate width, horizontal, armed with teeth of moderate size; teeth on the palatines, none on the vomer. Eye lateral, rather small. None of the opercles serrated. The anterior dorsal fin is continuous, formed by numerous slender spines. The soft dorsal and anal consists of an anterior lobe, followed by seven or eight finlets. Pectoral and ventral fins rather short. Caudal bilobed; tail with two keels at the base of the caudal. Pyloric appendages dendritic.

*Lepidothynnus huttonii*, n. sp. (Pl. VI. figs. A, A').

B. 7. D. 17 |  $\frac{2}{7}$  | VII. A.  $\frac{2}{9}$  | VIII. L. lat. 78–80. L. transv. 6 | 13 (below 2nd dorsal).

The body is broadest in front of the pectoral fin, the depth of this portion being about two-sevenths of the total length (without caudal). The head is nearly as deep as long, compressed into a crest, the small eye occupying a position in the middle of the depth of the head, but nearer to the end of the mouth than to the hind margin of the operculum. The cleft of the mouth is subhorizontal, extending backwards to below the middle of the eye. Gill-covers broad and firm as in Tunnies.

The body is covered with large cycloid scales (fig. *a.*), somewhat broader than long,  $1\frac{1}{2}$  inches broad. The lateral line follows the line of the back, after having made a curved ascent above the pectoral fin.

The spinous dorsal commences above the gill-opening, is low and long, and formed by seventeen slender spines. It is rather widely separated from the soft dorsal, whose anterior connected rays form a short falcate lobe; seven detached finlets follow. The anal corresponds in position and form to the soft dorsal. These vertical fins can be completely concealed in fissures on the back and abdomen.

Pectoral fin short and powerful as in a short-finned Tunny; ventral short, its root opposite to that of the pectoral fin.

Colour uniform steel-grey, lighter below; caudal fin and inside of the pectoral darker.

Professor Hutton has taken the following measurements:—

Total length, . . . . .	65½ inches.
Length of head, . . . . .	16½ „
Height of the body, . . . . .	16 „
Thickness at the pectorals, . . . . .	10 „
Breadth between eyes, . . . . .	6 „
Diameter of the eye, . . . . .	1 „
Length of pectoral, . . . . .	11 „
Longest dorsal spine, . . . . .	3 „
Height of soft dorsal, . . . . .	5¼ „
Height of anal, . . . . .	3¾ „

The skeleton resembles much that of a *Thynnus*. However, the vertebræ are of a less firm texture, somewhat porous, less deeply sculptured and lacking the high median lateral ridge which is so conspicuous on the centrum of the vertebra of a Tunny. The number of vertebræ is twenty-two or twenty-three in the abdominal, and twenty-one in the caudal division. None of the posterior caudal vertebræ are raised into the elevated lateral ridge of the Tunnies. The arrangement and form of the neural, hæmal, inter-neural, and interhæmal spines are as in *Thynnus*, but all are more slender, as are also the ribs and floating ribs. “Foramina inferiora”<sup>1</sup> seem to be present in the zygapophysis of the sixth to thirteenth caudal vertebræ. The hæmapophyses of the middle and posterior abdominal vertebræ coalesce to form a wide hæmal canal, but whilst in *Thynnus* the ribs are suspended from the extremities of the greatly prolonged hæmapophyses of these vertebræ, they are, in this genus, attached to the base of the apophyses. The neural spines of the seven posterior abdominal vertebræ do not bear interneurals.

The skull differs considerably in having a high crest developed along the whole length of its upper surface, but in other respects shows the closest agreement with that of the Tunny.

<sup>1</sup> See Lutken, *Vidensk. Selsk. Skriv.*, xii., 1880, p. 473.

*Thynnus thunnina* (C. V.), young (Pl. II. fig. D).

Dr. Lütken<sup>1</sup> has figured two very young Scombroïd fishes which he considers to be the young of *Orcynus germo*. A similar specimen 17 mm. long was obtained in the surface-net on the passage from the Admiralty Islands to Japan; it is, however, sufficiently different to prove its specific distinctness from the specimens figured by Dr. Lütken. All three specimens have a more or less extended black patch on the spinous dorsal, a feature which is commonly preserved in adult specimens of the genus *Cybium*, but which is much more rare in mature examples of *Thynnus*. I have seen it in the type specimen of *Thynnus affinis* of Cantor, from Penang, which is in fact specifically identical with *Thynnus thunnina*. Although I provisionally identify our young example with this latter species, I consider it quite possible that all these young specimens may belong to *Cybium*. Perhaps the young of two genera so closely allied as *Thynnus* and *Cybium* are not readily distinguishable.

Our young specimen is uniformly silvery, with the exception of the black patch which covers the first part of the first dorsal fin. Its body and tail are covered with minute scales which become visible when the surface of the specimen is allowed to dry. The head is large, at least one-third as long as the entire fish, the caudal fin included. Eye large, about two-sevenths of the length of the head; jaws armed with the strong teeth which are characteristic of the genus. Angle of the præoperculum armed with two stronger spines which are followed by smaller ones along the lower margin. The anterior part of the spinous dorsal fin is lower than in the fishes figured by Lütken, the posterior portion very low and continuous with the soft dorsal fin; there are altogether seventeen spines of which one would belong to the soft portion. All the rays of the soft dorsal fin, nineteen in number, are connected by membrane, but the seven or eight last are already sufficiently differentiated to show that they would have been modified into finlets. The anal fin is very similar to the second dorsal, consisting of twenty-three rays, of which the two or three anterior would have been converted into spines; the other anterior rays are very closely set, whilst the eight last are further apart and evidently finlets. The pectoral and ventral fins do not show any peculiarity. Caudal fin excised, the middle rays being quite free and not covered with scaleless skin as in the adult *Thynnus*. The trunk of the tail is very thin and depressed, provided on each side with the characteristic pair of keels, which prevents me from referring this specimen to the genus *Cybium*.

<sup>1</sup> *Vidensk. Selsk. Skriv.*, xii., 1880, pl. iii. figs. 1, 2.

*Echeneis remora*, L.

The following specimens were collected :—

- a-c.* 3–5 inches long. Atlantic, from a Shark ; April 9, 1876.
- d.* 6 inches long. Sandwich Islands, from a Shark ; August 21, 1875.
- e k.* 3–6½ inches long. North Pacific, from Sharks ; August 27, 1875.
- l.* 5 inches long. Atlantic, from Shark.

*Echeneis naucrates*, L.

Two specimens from St. Thomas, West Indies, and Kandavu.

*Echeneis albescens*, Schleg.

A specimen, 1¾ inches long, obtained north of New Guinea (Station 219), agrees entirely with an adult, with this exception that the caudal fin is comparatively longer and rounded, this fin having a vertical hind margin in the adult.<sup>1</sup>

*Hemerocoetes acanthorhynchus* (Forst.).

This fish is a littoral form, although it may occasionally be met far from land. Thus, on the passage from Sydney to Wellington, a young specimen, 2½ inches long, was found swimming close to the surface. The date of capture or the distance from the nearest land was not noted.

*Antennarius marmoratus*, Gthr.

Of this truly pelagic genus only the following specimens were brought home :—

- a.* 1 inch long. Between Tenerife and St. Thomas, West Indies.
- b-o.* ⅔–1½ inches long. Gulf-weed, south of Bermuda.

*Trigla macrodactylus*, n. sp. (Pl. III. fig. G).

A specimen, 16 mm. long, obtained off the coast of Sierra Leone on the surface, on April 11, 1876, shows some well-marked peculiarities. The snout is short, the forehead deeply concave, the body transparent, without pigmentation, except on the margin of the pectoral fin. The formula of the fins is—D. 9 | 15. A. 13. P. 11 | 3, which precludes this fish from being referred to any of the known species of the genus. The fin-rays are rather long, and the third of the pectoral fin is prolonged into a filament nearly as long

<sup>1</sup> See *Ann. and Mag. Nat. Hist.*, ser. 3, vol. v. p. 397, 1860.

as the fin. Whether this is a peculiarity of the young stage, or whether it is persistent throughout life, cannot be ascertained at present.

Messrs. Goode and Bean described (Bull. Mus. Comp. Zool., x. 1883, p. 210) a species of *Prionotus* which also possesses prolonged pectoral rays, but in that species it is the ninth ray which is most prolonged, and the succeeding rays are graduated, decreasing in regular proportion.

*Gobius* sp.

A young specimen,  $1\frac{1}{4}$  inches long, which I am unable to determine specifically, was obtained by the trawl in the Arafura Sea, on September 12, 1874, from a log of wood to which it had attached itself. The capture of this Goby is worth recording, as one of the instances by which we become acquainted with the means of dispersal of the species of this genus.

*Centriscus scolopax*, L.

This species, as well as the closely allied *Centriscus gracilis* of Lowe, are truly pelagic fishes. The latter has been known to occur in the Mediterranean and various parts of the North and South Atlantic, in the Japanese and Chinese Seas, and in the South Sea.<sup>1</sup> As to *Centriscus scolopax*, I have ascertained its occurrence on the coasts of Tasmania as far back as the year 1876,<sup>2</sup> and two of the three specimens obtained by the Challenger Expedition on the passage from Sydney to Wellington evidently belong to the same species.

All three specimens are young (from 6 to 13 lines long), and their dorsal spine is conspicuously shorter and weaker than in adult *Centriscus scolopax*, but longer and more distinctly denticulated than in *Centriscus gracilis*. They approach much more nearly to the typical form of the former species in the shape of their body, as may be seen from the following measurements :—

	Specimen from North Atlantic.	Specimen from South Pacific.
Total length, . . . . .	23 mm.	17 mm.
Distance between operculum and root of caudal fin, . . . . .	10 „	$7\frac{1}{2}$ „
Greatest depth of the body, . . . . .	5 „	$3\frac{3}{4}$ „
Length of dorsal spine, . . . . .	$3\frac{3}{4}$ „	$2\frac{3}{4}$ „

*Lophotes cepedianus*, Giorna, young (Pl. II. figs. K, K').

The discovery of the young of so scarce a fish as *Lophotes* must excite some surprise, but there is no other genus to which the little fish could be referred with

<sup>1</sup> Fische d. Südsee, p. 222.

<sup>2</sup> Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 395, 1876; referred to by Lutken, loc. cit., p. 585.

greater propriety than *Lophotes*. The specimen is only 11 mm. long and much distorted; it was obtained in April 1875 on the passage from the Admiralty Islands to Japan. It resembles much the adult form in the shape of its head and in the structure of its fins; the characteristic long and powerful dorsal ray is present though unfortunately broken off, only its basal portion being preserved. The chief difference from the adult is the proportion of the length of the body to that of the head, the body being much less elongate and the head only about two-sevenths of the total length. Differences of minor importance seem to be the position of the anterior dorsal ray, the root of which is somewhat behind the foremost part of the upper profile, and also the absence of the ventral fin, which may have been accidentally destroyed.

The embryonic condition of our specimen is clearly shown in the termination of the tail, which is heterocercal, a condition of which the last trace is indicated in the adult by the lateral line ending at the base of the upper, and not of the middle, caudal rays. In the dorsal fringe, as also in the other vertical fins, the rays are visible as minute and densely packed fibres.

The dorsal fringe surrounds the end of the notochord and is continuous with the portion (*c*) which, with growth, would be differentiated as the caudal fin, and in which the fibres are stronger and longer. The anal fringe (*a*) is separated from the caudal by the integument; a fringe (*pa*) similar to the anal exists in front of the vent (*v*), and runs for a short distance along the median line of the abdomen.

The fish is of a silvery colour, with pigment spots on the head, and others serially arranged along the terminal portion of the notochord.

Fig. K' represents the posterior end of the body much enlarged.

### III. ANACANTHS.

*Onus reinhardtii*, Collett (Pl. III. fig. F.).

Adult specimens of this species were obtained by the "Knight Errant" in the Færøe Channel at a depth of 540 to 640 fathoms in 1880.<sup>1</sup> Two years later three young specimens, referable to the same species, were caught at the surface by the "Triton" (August 9, 1882). They have the compressed body of the *Couchia*-stage of this genus, and are silvery, with a green back. Their fin-formula I make out to be—D. 52. A. 45. P. 20. V. 8. The greatest depth of their body is one-seventh of the total length, the length of the head a little less than one-fourth. The eye is one-fourth of the length of the head and equal to the length of the snout, this portion of the head being more pointed and more projecting beyond the lower jaw than in the young of the

<sup>1</sup> See Report on Deep-Sea Fishes, Zool. Chall. Exp., pt. lvii. p. 98.

other British species. The maxillary extends backwards to below the middle of the eye, and the skin of the upper as well as of the lower jaw is perforated by a series of conspicuous pores. The mandibular barbel is quite as long as the eye, and a small cirrus represents the nasal barbel on each side. The foremost dorsal spine is prolonged, about half as long as the head. Vertical fins low, caudal with straight posterior margin. Ventral fin very narrow, longer than the pectoral, about as long as the head without the snout.

Vent equidistant from the snout and the last anal ray. Scales not formed, visible as flat granulations of the skin on the hinder part of the tail.

? *Raniceps trifurcus*, Walb., young (Pl. III. fig. E).

The little fish, described and figured here, has been in my possession for several years, without my being able to obtain other specimens of more advanced age, by the aid of which its true relations could have been ascertained beyond doubt. It is 25 mm. long, and was obtained in the North Atlantic at the surface, in lat.  $52^{\circ} 33' N.$ , long.  $26^{\circ} 44' W.$  In referring it provisionally to *Raniceps*, a less amount of change has to be assumed to take place, than if it were associated with genera like *Phycis*, *Brosme*, &c. The fin-formula agrees fairly well with *Raniceps*, and it is possible that the rudimentary first dorsal fin of this genus is absent altogether in the young.

D. 69. A. 50. P. 24. V. 8. In the general form of the body this little fish resembles a *Couchia*; it is silvery, dark greenish on the back. Beside the very small mandibular barbel no other barbel can be distinguished. The length of the ventral fin is a conspicuous feature of this young fish, the middle rays being nearly as long as the head, and having the distal half of a black colour.

The depth of the body is one-fifth of the total length, the length of the head one-fourth. Eye large, longer than the short and obtuse snout, one-third of the length of the head. Cleft of the mouth oblique, with the maxillary reaching to below the middle of the eye.

The dorsal and anal fins are very low, the former commencing midway between the root of the ventral fin and the vent, and being preceded by a deep longitudinal groove, which runs along the middle of the back towards the head; no rudiments of an anterior dorsal fin can be discerned in it. Caudal fin as in *Couchia*, with a straight posterior margin. Pectoral fin with a broad base and the upper rays longest, reaching nearly as far back as the ventral. Ventral inserted on the side of the abdomen, a little in front of the root of the pectoral fin, and extending to the vent. Vent nearer to the root of the caudal than to the end of the snout.

*Bregmaceros* (Pl. III. figs. A-D).

The progress of our knowledge of this genus has been somewhat chequered. It was first described by William Thompson in Charlesworth (*Ann. and Mag. Nat. Hist.*, 1840, vol. iv. p. 184) from materials given to him by Cantor, viz., a young specimen 3 inches long, and a drawing which, with some serious imperfections, was reproduced as a woodcut to illustrate Thompson's description. The species was named *Bregmaceros maclellandii*, and the genus recognised as a member of the family of Gadoids.

Ignorant of the existence of this paper, Sir J. Richardson redescribed and figured the same fish in the *Voy. Sulphur*, *Ichthyol.* (1843), p. 94, pl. xlv. figs. 4-7, as *Calloptilum mirum*; and, although a much better figure was given by him, his description leaves as much to be desired as that by Thompson, owing to the small size of his examples, of which the largest was only 2·7 inches long, and is still preserved in the British Museum. He differed from Thompson in referring the genus to the Blennioid fishes.

Before comparing the descriptions given by these two zoologists, I must mention that Richardson himself in 1856 recognised the generic identity of the two fishes (*Encycl. Brit.*, ed. 8, vol. xii. p. 309), although he considered the species figured by him to be distinct from that described by Thompson. He also added to the generic diagnosis two apparently important characters, viz., *the absence of cæca and of an air-bladder*.

In 1862 I characterised the genus in the *Catalogue of Fishes* (vol. iv. p. 368) chiefly after Richardson, having no other material beside that used by my predecessor, and that considerably deteriorated. I differed from him, however, in adopting Thompson's views as regards the natural affinities of the genus, in giving different numbers of the fin-rays and scales, and, finally, in considering his *Calloptilum mirum* to be the same species as *Bregmaceros maclellandii*. My reasons for taking this latter view were, and are, the following:—

The different statements made by the authors as regards the number of dorsal and anal rays are to be accounted for by the uncertainty of the number of short and rudimentary rays in the middle of those fins. In some specimens it is impossible, and in all very difficult, to ascertain their number; nor is there such a marked break in the formation of the fin, that one could say exactly with which ray the anterior division ends and with which the posterior begins.<sup>1</sup> The difficulties are, of course, the greater, the smaller the specimens; thus, Richardson gave in the small specimen, which he figured, thirteen as the number of rays composing the posterior dorsal, whilst I count fifteen or sixteen in the same specimen, and up to twenty in others. Similar

<sup>1</sup> In my diagnosis I have, therefore, expressed this uncertainty by the mathematical symbol  $\epsilon$ , which by some subsequent writers has been copied as the roman figure X.



difficulties present themselves as regards the number of scales, which in young specimens are extremely thin and deciduous, and were mostly lost in the examples examined by Thompson, Richardson, and myself. The discrepancies in the statement as to the course of the lateral line, and the presence or absence of vomerine teeth, are likewise to be accounted for by the indifferent condition of the examples examined; and, finally, the black colour of the fins is a character which is absent in young specimens, but becomes more conspicuous with age.

Fully adult examples were first obtained by Lieut.-Col. S. R. Tickell, who in 1865 described them in Journ. Asiat. Soc. Bengal, p. 32, accompanying the description with a figure which, but for the scaling, would be a very good representation of the fish. The author was not sufficiently acquainted with the literature, and therefore described the fish as new, naming it *Asthenurus atripinnis*; however, the synonymy was rectified immediately afterwards by myself in the Zool. Record, 1866, p. 197. Tickell discovered the existence of vomerine teeth, and of an air-bladder; and although he denies the presence of a "lateral line," he expressly mentions and figures a "mesial groove with a ridge along each side," which groove is, in fact, the lateral line.

Singularly, the same specimens, which had been deposited by Tickell in the Calcutta Museum, were described again as new by Mr. F. Day (Proc. Zool. Soc. Lond., 1869, p. 522), as "*Bregmaceros atripinnis*, n. sp." The presence of vomerine teeth and a lateral line are denied in the diagnosis given by the author. Two pyloric appendages were found in this fish by the same author.<sup>1</sup>

A second and very distinct form was discovered in New Zealand and described by Mr. Hutton in 1873,<sup>2</sup> under the name of *Calloptilum punctatum*. He states (correctly as I now think) that this fish should be placed into a distinct genus, but his description, as well as figure, were by no means satisfactory. Having received a half-grown specimen of this fish in 1876, I corrected Hutton's description in several points, expressing it as my opinion that "it should not be generically separated from *Bregmaceros maclellandii*," an opinion which, with perfect and adult specimens before me, I am obliged to abandon.

Lastly, the relation of these fishes is treated of by Mr. F. Day again in 1877.<sup>3</sup> He treats of *Bregmaceros maclellandii* and *Bregmaceros atripinnis* as two distinct species, refers erroneously *Calloptilum punctatum* as a synonym of the latter, and misrepresents me as having identified the New Zealand fish with *Bregmaceros maclellandii*.<sup>4</sup>

Quite recently a fish apparently allied to these Indo-Pacific forms has been described by Messrs. Brown Goode and Bean,<sup>5</sup> from the Mid Atlantic, under the name of

<sup>1</sup> Proc. Zool. Soc. Lond., 1873, p. 112.

<sup>2</sup> Trans. and Proc. New Zealand Inst., vol. v. p. 267, pl. xi., 1873.

<sup>3</sup> Fishes of India.

<sup>4</sup> I must also demur to this author crediting me with the grammatically erroneous term of "*Bregmaceros punctatum*," *Bregmaceros*, formed like *Rhinoceros*, is of the masculine gender.

<sup>5</sup> Bull. Mus. Comp. Zool., vol. xii. p. 165, 1886.

*Bregmaceros atlanticus*. Six specimens, the largest nearly 50 mm. long, were obtained by the "Blake," at depths varying from 90 to 305 fathoms. This occurrence, taken together with the facts that the Challenger obtained a young specimen in the open sea in the Pacific, that *Bregmaceros maclellandii* has a black-coloured pharynx, and that *Bregmaceros maclellandii* and *Bregmaceros punctatus* possess deeply sculptured cranial bones with wide muciferous cavities, proves that these fishes inhabit the open sea, and descend to considerable depths, although they seem not rarely to be met with close to the shore.

I have mentioned above that I agree now with Mr. Hutton in regarding the New Zealand form as the type of a distinct genus; Mr. Hutton adopted the second generic name given to *Bregmaceros maclellandii*, *Calloptilum*, for the genus which he established for the New Zealand fish, but according to a generally accepted rule of nomenclature, this course is not admissible, and a new name has to be given to the latter. It is not possible at present to determine to which of the two genera the young specimens obtained by the Challenger and "Blake" should be referred. The dorsal and anal fins are but little differentiated in the young of all these species, and the structure and changes of their ventral fins are very imperfectly known.

I proceed first to give the distinctive characteristics of the two genera :—

*Bregmaceros*, Thomps. = *Calloptilum*, Rich. = *Asthenurus*, Tick.

Body fusiform, compressed posteriorly, covered with cycloid scales of moderate size. Two dorsal fins, the anterior reduced to a single long ray on the occiput; the second and the anal more or less depressed in the middle, in adult specimens the middle rays becoming more or less obsolete, so that the fin appears to be divided into two. Ventral fins well developed, composed of five rays, the three outer of which are dilated and much elongated. Minute teeth in the jaws and on the vomer. Air-bladder large. Pyloric appendages few in number (two). Gill openings very wide, the gill membranes being united below the throat, and not attached to the isthmus. Pseudobranchiæ none. Branchiostegals seven.

*Auchenoceros*, Gthr. = *Calloptilum*, Hutt. nec Rich.

Head and body compressed, elongate, covered with small, exceedingly delicate and deciduous scales. Two dorsal fins, the anterior reduced to a single long ray on the neck, above the pectoral; the second more or less depressed in the middle; one anal. Ventral fins rudimentary, each composed of two slender elongate rays. Minute teeth in the jaws, none on the vomer. Air-bladder small. Pyloric appendages in moderate number (eight). Gill openings very wide, the gill membranes not being attached to the isthmus. Pseudobranchiæ none.

I note the following details for specific descriptions :—

*Bregmaceros maclellandii*, Thompson (Pl. III. figs. A, B).

*Bregmaceros maclellandii*, Thompson.

*Calloptilum mirum*, Richards.

*Bregmaceros maclellandii* (syn. *Calloptilum mirum*), Gthr.

*Asthenurus atripinnis*, Tickell.

*Bregmaceros atripinnis*, n. sp., Day.

*Bregmaceros atripinnis* (excl. synonym.), and *Bregmaceros maclellandii*, Day.

D. 1 | 16-19 +  $x$  + 15-21. A. 22-30 +  $x$  + 20-22. V. 5-6. L. lat. 64-70.  
L. transv. 14-16.

In an adult specimen from the Indian Ocean (Pl. III. fig. A)  $4\frac{1}{2}$  inches long, the greatest depth of the body is below the origin of the soft dorsal fin, and contained five and a half times in the total length, without caudal. The head is small, short and broad, its length being contained six and a half times in the total length. The eye is rather large, two-sevenths of the length of the head, and equal to the width of the interorbital space; its upper half is covered with a transparent membrane. Snout short, shorter than the eye, obtuse, rounded, the lower jaw being received within the upper. Mouth of moderate size, the maxillary not extending to the hind margin of the orbit. Teeth in the jaws very minute, and those on the head of the vomer scarcely perceptible. The isthmus is broad and muscular, forming a broad support to the powerful ventral rays. The distance of the vent from the root of the ventral fins exceeds considerably the length of the head. The anterior dorsal ray is inserted above the præoperculum, and considerably longer than the head; it can be received in a groove on the back. The second dorsal fin commences opposite to the vent; its anterior portion is triangular in shape, with the longest rays about as high as the body underneath; a space about as long as the base of the preceding portion follows, and is occupied by a variable number of short and rudimentary rays. These rays gradually increase in length again, and form the posterior portion of the dorsal fin, which, however, is scarcely half as high as the anterior portion, and terminates at a short distance from the caudal. The anal fin commences and terminates almost opposite to the dorsal, resembling this latter in form and structure, but with a greater number of rays composing the developed portions. The caudal fin is short, with the hind margin slightly excised.

The pectoral fin is inserted rather high up the sides, and strongly asymmetrical; it is many-rayed, the rays being inserted on a long and broad base.

The ventral fins ( $a$ ) exhibit a very extraordinary structure, and seem to be as much organs of touch as of locomotion. Each fin is composed of five or six rays, of which the three outer ones are enlarged, much prolonged, bearing a dilatation along each edge ( $a'$ , enlarged), and terminating in fine points. The two outermost rays are quite free, the

others being connected by membrane. The two or three innermost rays are quite short and much branched.

The ventral fins can be laid backwards in a groove running along the middle of the abdomen, and along each side of the anal fin backwards to its middle.

The whole fish is silvery, minutely dotted with brown, but these dots are visible in adult fish only after the scales have been removed. The vertical fins, the pectorals and the short ventral rays are black, which colour is only gradually assumed as the fish grows older. In very young specimens all the fins are pellucid. The pharynx is black.

A specimen obtained by the Challenger near Amboina,  $12\frac{1}{2}$  lines or 27 mm. long, agrees in all points with the adult, especially in the structure and form of the fins; only the head is comparatively longer. But in a specimen of 7 lines or 15 mm., of which unfortunately only a drawing could be preserved, the sections of the dorsal and anal fins are not yet differentiated; these fins being subcontinuous with the caudal (see Pl. III. fig. B). In this drawing no pectoral fin is shown.

*Auchenoceros punctatus*, Hutton (Pl. III. fig. C).

*Calloptilum punctatum*, Hutton.

*Bregmaceros punctatus*, Gthr.

D. 1 | 18-22 +  $x$  + 32. A. 57-60. V. 2.

In a specimen  $4\frac{1}{4}$  inches long the greatest depth of the body is below the origin of the soft dorsal fin, and contained five times and three-fourths in the total length without caudal; the head is compressed and nearly one-fifth of the total length. Eye of moderate size, as long as the snout, a little less than two-sevenths of the length of the head or than the width of the interorbital space. Snout as long as the eye, with the cleft of the mouth oblique, the lower jaw slightly projecting beyond the upper; mouth rather wide, the maxillary not extending to the hind margin of the orbit; teeth in the jaws villiform, vomer and palatine bones toothless. The isthmus is very narrow. The distance of the vent from the root of the ventral fins is not more than the length of the head without snout.

The anterior dorsal ray is inserted above the root of the pectoral and about as long as the head; there is no groove on the back for its reception. The second dorsal fin commences behind the vent; its anterior portion is lower than the body underneath; a space longer than the base of this portion follows, and is occupied by a variable number of very rudimentary rays. These rays gradually increase in length again, and form the posterior portion of the dorsal fin, which, however, is not half as high as the anterior portion, and terminates at a short distance from the caudal. The anal fin commences immediately behind the vent, that is, in advance of the dorsal, and terminates opposite to the last dorsal ray; its middle rays are but slightly shortened; the caudal fin is rounded,

of moderate length, embracing a considerable part of the tail, the rudimentary rays advancing far forward on the upper and lower sides of the tail.

The pectoral fin is inserted in the middle of the side, asymmetrical, many-rayed, as long as the head. The ventral fins (*c*) are inserted at some distance from each other; their base is very small, and each is composed of two very slender rays, the longer of which reaches beyond the vent.

The scales are lost but to judge from the folds of the skin they must have been extremely thin and very small.

The entire fish is uniformly silvery.

A young specimen (Pl. III. fig. D), 19 mm. long, obtained on the 15th of September 1873, indicates the presence of another species in the Pacific, but as the specific characters in this genus evidently change with age, I hesitate to introduce it with a distinct specific name. It seems to have a smaller eye than the other species; the ventral fins are two-rayed but much stronger than in *Auchenoceros punctatus*; the anterior dorsal ray is placed opposite to the operculum; the long dorsal and anal fins commence opposite to each other; they are not divided into separate portions and continuous with the caudal fin; but this is probably only a sign of young age.

*Fierasfer acus*, Brunn., young (Pl. IV. fig. F).

In the year 1860, Kaup<sup>1</sup> described a small fish in the British Museum as the type of a new genus, *Porobronchus*. T. Gill<sup>2</sup> alludes to it in these words:—"As to *Porobronchus*, Kaup, it is, perhaps, related to *Fierasfer*; but the character of the first elongated dorsal ray requires to be known before a decision can be arrived at;" whilst I<sup>3</sup> stated it to be the young of *Fierasfer acus*. It is 2½ inches long and not in a good state of preservation. A very similar fish, probably of the same species, was examined by Gasco<sup>4</sup> who published almost simultaneously with my observation a description and figure of it, considering it to be the type of a new genus, *Vexillifer*. His specimen was 20 mm. long and re-examined by Costa<sup>5</sup> who adopted Gasco's nomenclature. However, some years later, Emery<sup>6</sup> confirmed my view as to the nature of this fish, from an examination of very young examples which are undoubtedly *Fierasfer acus*.

The most conspicuous characteristic of these young *Fierasfer* is the presence of an extremely long anterior dorsal ray which bears a variable number of small skinny lobes. As the fish grows, this ray is lost or shortened by absorption. The specimens observed by the Italian naturalists showed this ray more or less completely developed, whilst in Kaup's specimen the greater part of the ray and every trace of the lobes had dis-

<sup>1</sup> *Ann. and Mag. Nat. Hist.*, 1860, ser. 3, vol. vi. p. 272, pl. iii. fig. D.

<sup>2</sup> *Ann. and Mag. Nat. Hist.*, 1865, ser. 3, vol. xv. p. 48.

<sup>4</sup> *Bull. Assoc. Natur. e Med. Napoli*, 1870, April, p. 59, c. tab.

<sup>5</sup> *Ann. Mus. Zool. Napoli*, vi., 1871, p. 88, tav. 2, fig. 1.

<sup>6</sup> *Atti Soc. Ital. Sci. Nat.*, xxi. 1878, p. 37, figs. 1-3; and *Atti R. Accad. d. Lincei*, 1879-80, vol. vii. tav. 1, a.

<sup>3</sup> *Catal. Fish.*, vol. viii. p. 145, 1870.

appeared. In the specimen which I describe here, it is reduced to a short rudiment. Evidently it is of use only whilst the young fish leads a free and pelagic life, and disappears when the *Fierasfer* assumes the habits of a commensal.

There cannot be much doubt as to our specimen representing a more advanced stage of the young of *Fierasfer acus*, the resemblance of its head and of the proportions of its body to young *Fierasfer acus* from the Mediterranean being very great. However, it should be remembered that that species has hitherto not been found so far northwards as the British Channel, whilst another species of the genus, *Fierasfer dentatus*, is known, though from two specimens only, to occur on the Irish coast.<sup>1</sup> We possess two representations of the young of this species, a very rude one by Putnam,<sup>2</sup> and an excellent one by Emery,<sup>3</sup> both of which agree in showing that the young of *Fierasfer dentatus* is a much more slender form than that of *Fierasfer acus*. The latter species therefore has to be added to the British fauna.

The specimen is 104 mm. long, the head measuring  $5\frac{1}{2}$  mm., and the distance of the snout from the beginning of the anal fin 11 mm. Head and tail are much compressed, the latter terminating in an extremely fine filament into which the vertebral elements do not enter. The eye is of moderate size, rather shorter than the snout, which is obtuse, with the jaws equal in front. The maxillary extends beyond the centre of the eye and the few teeth which can be observed are minute. The abdomen projects much, the vent being behind and not in front of the projection. The dorsal fin commences very little in advance of the anal; of the long ray which is so remarkable a feature in very young specimens, only a short rudiment remains. The fin behind the ray is at first only a low ridge which becomes higher towards the middle of the length of the tail, and decreases in height again behind. In its entire course it is conspicuously lower than the anal fin, which, about the middle of its length, is nearly as high as the body above.

The specimen was obtained on August 9, 1882, in the Farøe Channel, close to the surface, during the cruise of H.M.S. "Triton."

Of the two figures on Plate IV. the upper represents the specimen of the natural size, the lower the anterior part of the body enlarged.

#### PLEURONECTIDÆ.

Eight young specimens were obtained in the Mid Atlantic swimming at the surface at night, on August 16, 1873, and on April 18, 1876. They are 1 inch long, perfectly symmetrical, and agree entirely with the "pelagic Plagusæ" of the same size described and figured by Steenstrup. They do not throw further light on their origin, which is still obscure.

On April 11, 1876, when sailing off the coast of Sierra Leone in lat.  $7^{\circ} 33' N.$ , and

<sup>1</sup> Collett has described another specimen from Norway, *Christian. Vidensk. Forhandl.*, 1882, No. 19, c. tab.

<sup>2</sup> *Proc. Boston Soc. Nat. Hist.*, 1874, vol. xvi. p. 347 (*Encheliophis tenuis*).

<sup>3</sup> *Atti R. Accad. d. Lincei*, 1879-80, vol. vii. tav. 1, a.

long.  $15^{\circ} 16' W.$ , small Pleuronectidæ were obtained in the towing-net, the relation of which to adult forms is at present likewise perfectly obscure.

They (Pl. I. fig. B) have a length of 6 and 7 mm. The notochord is distinct in its whole course, with its diphyccercal termination. The eyes are symmetrical; no pigment is to be seen on any part of the body except in three spots placed in a triangle opposite to the end of the notochord. The fin-rays are perfectly developed, no part of the embryonic fin-membrane remaining. The dorsal and anal portion pass uninterruptedly into the rayed fringe surrounding the termination of the tail. Very peculiar is an exceedingly long filamentous ray placed in front of the dorsal fin somewhat in advance of the eye. Neither pectoral nor ventral fins can be distinguished, but this may be owing to the condition of the specimens, which were mounted for microscopical examination immediately after their capture. Also the configuration of the bones of the side of the head is indistinct, but the mouth appears to have been of moderate width, and is armed with a few tooth-like apophyses.

Another larval Pleuronectoid, figured on Pl. IV. fig. E, is possibly the young of a *Solea*. It is only  $5\frac{1}{2}$  mm. long, and was obtained at the surface, off the mouth of the Plate River on February 26, 1876. It was stained and mounted for the microscope, scarcely more than the outlines being visible; the posterior outlines of the head are very indistinct. The specimen is not far advanced beyond the embryonic condition, and its abdomen protrudes as a rounded sac. The tail tapers and is diphyccercal; eyes and the small mouth symmetrical. Snout very short, with a parabolic outline; eye small, nearer to the angle of the mouth than to the upper profile. Fin-rays are developed and differentiated only anteriorly on the back, the remainder of the fin showing a finely striated appearance throughout its length, in its continuation round the end of the tail to the vent. The two first fin-rays stand above the eye, are much elongate, nearly 3 mm. long, and are followed by about eight developed rays. Pectoral and ventral fins apparently absent.

In a young Pleuronectoid (Pl. IV. fig. D),  $13\frac{1}{2}$  mm. long, obtained in the surface-net on the passage from the Admiralty Islands to Japan, March 1875, the fins and rays are much more developed. The body is whitish, semitransparent, like that of a *Leptocephalus*, the eyes and mouth are symmetrical. The anterior profile of the snout is parabolic; the small eye is close to the anterior profile, above the angle of the narrow mouth. Abdomen pendent and protruding. Pectoral well developed, on both sides, with broad base; a rayed fold of the integument, attached to the abdominal sac, represents the ventral fin. The vertical fins are continuous, but the caudal projects as a distinct portion and is composed of twelve rays. Dorsal rays about one hundred, anal seventy-four.

This large number of fin-rays would seem to indicate that this fish is the young of some species of *Synaptura*.

## IV. PHYSOSTOMI.

*Scopelus*, Gthr.

In the Report on the Deep-sea Fishes (p. 195) I have already shortly described the habits of these fishes. They are truly pelagic, but rarely or accidentally coming into the vicinity of land. They are exceedingly common in all seas of the Tropical and Sub-tropical zones, becoming scarcer in higher latitudes, a few species reaching the Arctic and Antarctic circles. Some of the species have a very wide range, and the limits of distribution of others are determined by latitude rather than longitude.

Of the numerous specimens obtained by the Challenger only a few were adult, the majority under 18 lines long, the smallest measuring from 5 to 7 mm. These younger specimens were generally destitute of scales and semipellucid; neither had they the phosphorescent organs developed. In two of the larger individuals, about 1 inch long, the scaly covering was perfect, but of the phosphorescent organs only a few on the side of the head and one at the root of the ventral fin were developed. I was unable to decide whether this paucity of phosphorescent organs indicates specific distinctness or is characteristic of stages of growth.

The specific determination of the majority of these small *Scopeli* is not only a matter of considerable difficulty, but generally of great uncertainty. It would be impossible to avoid mistakes which of necessity would lead to erroneous notions as to the occurrence of a species at a certain season in some area of the ocean. The following species, however, could be made out with a sufficient degree of exactness:—

1. *Scopelus caninianus* (Mus. Brit., an Cuv. Val?). This species is not confined to the Mediterranean and Atlantic, where a specimen 3 inches long was obtained off the Cape Verde Islands on April 28, 1876, but is also tolerably common in the Pacific. Specimens from 20 to 36 lines long were caught at night in the tow-net in the neighbourhood of New Guinea, on November 5, 1874, and February 26, 1875, and also on the passage to the Admiralty Islands.

2. *Scopelus coccoi* (Cocco). Of this small but most common and most widely distributed species some eighty specimens were collected; south of Cape Verde Islands (April 28, 1876), on the passage to the West Indies, in the South Atlantic (March 7, 1876), in the South Pacific (October 20 and November 5, 1875), in Mid Pacific (August 25, 1875), near the Admiralty Islands, and on the passage to Japan. The size of the specimens ranged from  $\frac{1}{2}$  to  $2\frac{1}{4}$  inches.

3. *Scopelus nigro-ocellatus* (Gthr.). The type, the only specimen previously known,



was caught in the South Atlantic. Two specimens,  $1\frac{1}{2}$  inches long, were obtained during the passage of the Challenger from the Admiralty Islands to Japan (April 1875).

The other species of this genus obtained during the voyage were described in the deep-sea series, as there was no reason to doubt their occurrence beyond the 100 fathom line.

Finally, during the cruise of the "Triton" in the Færøe Channel in 1882 a small number of young *Scopeli* were obtained, partly with the surface-net at night, partly with the tow-net, which with a line of 350 and 600 fathoms was worked at various depths. The dates of capture were on August 9, 20, 21, and 30. Their length varies from 9 to  $16\frac{1}{2}$  mm., the largest being perfectly developed, and having their specific characters sufficiently distinct. Unfortunately the scales are either entirely, or for the greater part, lost.

I am unable to refer these specimens to a described species of the genus. They differ especially from the other species described from northern seas (*Scopelus glacialis*, *Scopelus krøyeri*), either by the number of the fin-rays, or by a conspicuously smaller eye; they come nearest to *Scopelus glacialis*, and also to a species known from New Zealand (*Scopelus hectoris*), but differ from the latter in the relative position of the dorsal and ventral fins. There is, therefore, sufficient ground for introducing this new addition into the British fauna<sup>1</sup> under a distinct name.

*Scopelus scoticus*, n. sp.

D. 10-11. A. 16. C. 8 | 20 | 8.

Total length  $16\frac{1}{2}$  mm. The height of the body ( $3\frac{1}{3}$  mm.) is two-ninths of the total length (without caudal, 2 mm.), the length of the head ( $2\frac{2}{3}$  mm.) one-fourth; the least depth of the tail is much less than one-half of that of the body. Diameter of the eye rather longer than the snout, but less than one-third of the length of the head and considerably less than the postorbital portion of the head. Snout with the upper profile rather straight, curved in front only, and with the lower jaw slightly projecting beyond the upper. Maxillary reaching to the angle of the præoperculum, and terminating in an elongate triangular dilatation. Posterior margin of the præoperculum vertical. Scales of the lateral line apparently not larger than the others; phosphorescent organs in the same number and arrangement as in the allied species. Origin of the dorsal fin nearer to the root of the caudal than to the end of the snout, behind the base of the ventrals. Pectoral rather short.

In a specimen 14 mm. long the scales are developed, also nearly all the phosphor-

<sup>1</sup> The cruise of the same vessel yielded another addition to the bathybial fauna of the British seas. A specimen of *Stomias ferox* (Reinhardt), 37 mm. long, was obtained in the dredge on August 9, 1882, at a depth of either 327 or 430 fathoms.

escent organs are present, some with a silvery centre, surrounded by a pigmentary ring, others without the silvery centre.

A specimen,  $11\frac{1}{2}$  mm. long, is semitransparent, whitish, without scales; of the phosphorescent organs only the one on the side of the head, covered by the præopercular limb, is visible as a black round pigment spot.

Specimens, 9 mm. long, are without any trace of phosphorescent organs; but the fins and fin-rays are perfectly differentiated.

This species seems to lack the phosphorescent organs on the back of the caudal peduncle.

### *Diplophos.*

*Diplophos*, Günth., Journ. Mus. Godeffroy, ii. 1873, p. 101.

Body much elongated, band-shaped (covered with large thin deciduous scales?). A double series of phosphorescent organs runs along the lower side of the body and tail. Head compressed, with pointed snout and projecting lower jaw. Mouth very wide but slightly oblique; jaws armed with small pointed teeth rather unequal in size; eye of moderate size; paired fins well developed; dorsal fin in advance of the anal, behind the ventral; adipose fin none; anal very long.

### *Diplophos tænia* (Pl. IV. fig. C).

*Diplophos tænia*, Günth., loc. cit., p. 104.

D. 8. A. ca. 43. V. 8.

The length of the head is one-sixth of the total length, the greatest depth of the body only one-sixteenth. Snout more than twice as long as the eye, pointed, with the lower jaw longest. The maxillary reaches backwards far behind the eye. Dorsal fin short, its first ray somewhat nearer to the end of the snout than to the root of the caudal; anal fin commencing below the last dorsal ray, and ending at a short distance from the caudal. Paired fins short; pectoral inserted near to the lower profile; ventrals reaching nearly to the origin of the dorsal. The phosphorescent organs are rounded black bodies, without silvery centre; they are very numerous and arranged in two parallel series along each side of the lower profile. Those of the upper series are smaller than those of the lower, are quite round and do not extend so far towards the head and the caudal, as the lower. The lower are larger and transversely oblong. A pair of still larger luminous organs occupies a position in front of the base of the lower caudal rays. Brownish.<sup>1</sup>

The largest of three specimens is only  $1\frac{1}{2}$  inches long; they were obtained at night by the tow-net in lat.  $30^{\circ}$  S., long.  $24^{\circ}$  W.; and in lat.  $22^{\circ}$  N., long.  $30^{\circ}$  W.

<sup>1</sup> After fifteen years' immersion in spirit the colour of these specimens is faded into dull white.

*Diplophos pacificus*, n. sp. (Pl. IV. fig. B).

D. 12. A. 53. P. 9. V. 7.

The length of the head is one-fifth of the total length, the greatest depth one-tenth. Snout thrice as long as the eye, and the maxillary extending far behind the eye, nearly to the præopercular angle; eye one-seventh or one-eighth of the length of the head. Cheek covered by the enlarged suborbital bones. Dorsal fin higher than the body, its origin nearer to the end of the snout than to the root of the caudal fin; its last rays are opposite to those of the anal. Anal extending to within a short distance of the caudal fin, its anterior rays are longest, but shorter than those of the dorsal; ventral fin rather long, reaching to the origin of the dorsal fin, more than twice as remote from the pectoral as from the dorsal. A singular spine-like projection opposite to the last anal ray may be an accidentally detached portion of the root of the caudal fin, or represent a rudimentary adipose fin.

The phosphorescent organs are arranged as in *Diplophos tænia*, but are more developed, having a silvery centre with a black ring, not only those of the main series but also the smaller ones of the secondary series. Another series of small organs runs along the middle of the side of the body and seems to be a specialized lateral line. Other luminous organs, but very indistinct, can be seen on the hyoid bone.

Brownish, with silvery lustre.

A single young specimen of this interesting fish was obtained on September 2, 1875, in Mid-Pacific (lat.  $5^{\circ} 54' N.$ , long.  $147^{\circ} 2' W.$ ), in the tow-net which had been attached to the dredge. Although the dredge descended to a great depth, there is no doubt that the specimen was obtained close to the surface; it is 37 mm. long, that is, nearly of the same length as the typical specimen of the Atlantic species. It had been mounted as a microscopic preparation in glycerine, and has suffered considerably from this mode of preservation. Although nearly of the same size as the types of the Atlantic species, it is more advanced in development, as is evident from a comparison of the luminous organs.

*Fundulus nigrofasciatus*, Lesueur.

A specimen,  $1\frac{1}{4}$  inches long, was obtained on the passage from Tenerife to St. Thomas, West Indies, in the tow-net, in company with other pelagic surface fishes.

The capture in mid-ocean of a species inhabiting the fresh and brackish waters of the Atlantic States of North America is of great interest. It illustrates the way in which reputed fresh-water species are spread to distant coasts by crossing wide expanses of ocean. The wide and irregular distribution of Cyprinodonts generally is probably to be thus accounted for.

Ovum of a *Scombresocid* (Pl. V. fig. E).

The surface-net enclosed in the Atlantic on February 29, 1876, a single ovum, 2.5 mm. in diameter, which by the development on its surface of long filaments proves to be that of a member of the family of Scombresocidæ. The embryo is considerably advanced in development, its outlines being clearly visible. The ovum differs from that of *Belone* and *Scombresox* in having shorter and fewer filaments; also the filaments have no swelling at the base. It may be that of an *Exocoetus*, the ovum of which I believe is still unknown.

The ovum, which was mounted in glycerine for the microscope immediately after capture, gives the impression of a regular arrangement of the filaments in four concentric circles on each hemisphere, and with a single filament at each pole.

*Hemirhamphus* sp., young.

One specimen only can be referred with certainty to this genus, but it is not sufficiently advanced in growth to determine the species. It is  $1\frac{1}{8}$  inches long, and was captured on the passage from Tenerife to St. Thomas in the West Indies. The lower jaw projects  $\frac{3}{8}$  of an inch beyond the upper, the latter being short and broad as in the mature fish; no teeth whatever can be distinguished in this specimen.

*Scombresox*, young.

The fry and young of this genus belong to the most common forms of pelagic life, and numerous specimens up to  $1\frac{2}{3}$  inches in length were captured by the tow-net. Those from the Atlantic I have referred to *Scombresox saurus*, and those from the Pacific to *Scombresox forsteri*, without being able to discover in these immature specimens the slight differences by which those closely allied species are distinguished. Of the dates of capture of the Atlantic specimens were noted March 7, April 28, and May 7 (1876); the Pacific specimens are from 1 to  $1\frac{2}{3}$  inches long, and were captured on various occasions in the month of July, 1875.

*Belone* sp., young.

Among the numerous pelagic young Scombresocidæ collected by the Challenger, or obtained from other sources, there is only one which I can refer without hesitation to *Belone*. It was caught in September about forty miles north of Demerara, and is 21 mm. long. It cannot be determined specifically. The body is subcylindrical in shape with a rather elongate caudal fin. Both jaws are prolonged and toothed, but the length

of the lower, measured from the eye, is  $4\frac{1}{2}$  mm., whilst the upper measures 2 mm. only. The basal half of the lower jaw is armed on the sides with strong curved teeth rather distantly placed, the teeth of the upper jaw being smaller, more closely set, nearly uniform in size, and occupying the entire length of the intermaxillaries.

*Exocoetus*, L.

Of this pelagic genus comparatively few specimens were obtained, the majority being young. The fins do not seem to undergo important changes with growth, with the exception of the caudal fin, which I have found in some specimens, not in all, unusually long. The coloration is not a reliable guide in the determination of young examples, for whilst the colours which ornament the mature fish, especially the fins, in some of the species, are not developed in the young, bands and spots of brown or black colour adorn the young of other species, but disappear with age.

The specimens collected by the Challenger are referred to the following species :—

*Exocoetus obtusirostris*, Gthr.

Beside a specimen, 8 inches long, which entered the tow-net at night in the North Atlantic on April 28, 1876, and which undoubtedly belongs to this species, five other examples, from 1 to  $2\frac{1}{4}$  inches long, were obtained on various occasions in the Tropical Atlantic (August 14, 1873; April 28, 1876). These young specimens might be referred with equal right to *Exocoetus evolans*, L.

*Exocoetus spilurus*, Gthr.

This species is known from young specimens only. Two, 1 to  $1\frac{1}{4}$  inches long, were obtained by the Challenger in Gulf-weed, south of Bermuda.

*Exocoetus solandri*, C. V. (Pl. IV. Fig. A).

*Exocoetus solandri*, Cuv. Val., xix. p. 129.

In my general account of the Flying Fishes,<sup>1</sup> I have already shown that the fish from Otaheiti, described by Solander and figured by Parkinson, is a different species from the Flying Fish from the Seychelles, with which Valenciennes had identified it, dedicating it to the memory of Solander. Some time ago I found among a number of East African specimens a Flying Fish which closely agrees with Valenciennes' description, showing at the same time that the specimen which I had formerly referred to *Exocoetus solandri*,

<sup>1</sup> Catal. Fish., vol. vi. pp. 280, 285.

and from which I drew up a diagnosis, must belong to another and distinct species. Its pectoral fins and manibulary appendages are, however, too much injured to allow of its characteristics being ascertained. I take now this opportunity of giving a diagnosis of the true *Exocoetus solandri*:—

D. 12. A. 11.

Form of the body very slender, its depth being only one-seventh of the total length (without caudal), the length of the head one-fifth. Snout rather long and pointed, the mandible projecting; eye a little shorter than the snout, and two-sevenths of the length of the head.

The anterior part of each mandible is furnished with a broad, delicate, black skinny flap, bearing on its edge several cirrhi, some longer than others, as long as the eye. The dorsal fin is very high, its longest (middle rays) extending to the middle of the upper caudal lobe; the anal is only half as high, its first ray being opposite to the third or fourth of the dorsal. Pectoral fin reaching to the end of the base of the dorsal; its upper ray simple, two-thirds the length of the third, the second ray forked, the third the longest. Ventral fin inserted midway between the root of the caudal and the eye, and reaching to the caudal. (Scales lost.) Silvery with greenish back; three broad (rose-coloured?) bars cross the abdomen in front of the ventral fins; another bar behind the ventral, and a more indistinct one across the front of the base of the anal fin. The greater part of the dorsal fin, the postero-inferior half of the pectoral, and the ventrals black; an oblique band across the lower caudal lobe and the outer half of the anal fin blackish.

The specimen is  $5\frac{2}{3}$  inches long.

*Exocoetus naresii*, n. sp. (Pl. I. fig. A).

D. 10. A. 8. L. lat. 45.

Allied to *Exocoetus comatus*, but with less dorsal rays and longer fins; a single black, very long and broad, cutaneous appendage, which fringes the lower jaw in its entire circumference, does not quite extend to the root of the ventral fin; it is supported by a mid-rib of a whitish colour. The pectoral fin extends to the last dorsal ray, the ventral to the root of the caudal. The ventral is inserted midway between the head and the root of the caudal. Dorsal fin rather low. The height of the body equals the length of the head without snout, the length of the head being one-fourth of the total (without caudal). Snout shorter than the eye, which is one-third of the length of the head; interorbital space scarcely concave, broad, its width being more than the diameter of the eye. Pectoral blackish, with the exception of the three or four lower

rays; posterior rays of the dorsal and anal fin blackish; ventrals black, with the inner and outer rays white.

One specimen, 7 inches long, came on board ship between the Fiji and New Hebrides Islands, August 16, 1874.

(?) *Exocoetus affinis*, Gthr.

Two specimens, 1 and  $1\frac{1}{4}$  inches long, were obtained in Gulf-weed, south of Bermuda. It is impossible to determine whether these young *Exocoetus* should be referred to *Exocoetus lineatus* or the allied *Exocoetus affinis*.

*Exocoetus rondelletii*, C. V.

Two specimens,  $\frac{3}{4}$  and 1 inch long, off the Cape Verde Islands, on April 24 and 29, 1876.

*Exocoetus simus*, C. V.

*Exocoetus simus*, Cuv. Val., xix. p. 105.

Not having had a specimen of this species before, I give here a detailed specific description.

D. 12. A. 8. L. lat. 46.

Closely allied to *Exocoetus callopterus* and *Exocoetus brachysoma*.

The height of the body is one-fifth or less than one-fifth of the total length, the length of the head one-fourth or less than one-fourth. The depth of the head is somewhat more than the distance between the extremity of the snout and the hind margin of the præoperculum. Snout obtuse and depressed, its length being three-fifths of the diameter of the eye, which is a little less than one-third of the length of the head, and less than the width of the interorbital space, which is flat. The pectoral fin extends to, or somewhat beyond, the end of the dorsal. Ventral fins midway between the root of the caudal and the gill-opening, not extending to the end of the base of the anal. The dorsal commences far in advance of the anal, its anterior rays being half as long as the head. *The distance between the first dorsal ray and the first rudimentary caudal ray is conspicuously more than the length of the head.* There are thirty-one scales between the occiput and the origin of the dorsal, and eight longitudinal series of scales between the origin of the dorsal and lateral line. Some (the largest) specimens have some round black spots in small or at least not considerable number between the pectoral rays. In other specimens these spots are only indicated, and again in others

entirely absent, the lower rays being whitish. Ventrals nearly uniformly white, or with the outer ray slightly tinged with grey. No black on the dorsal fin.

This is the first species of *Exocoetus* in which I have found the coloration of the pectoral fin varying. There can be no doubt as regards the specific identity of the specimens before me.

Ten specimens, from  $10\frac{1}{2}$  to 13 inches long, were obtained at Honolulu. The Sandwich Islands seem to be the only locality at which this species has been found hitherto.

*Astronesthes niger*, Rich.

This fish was included in the Report on Deep-Sea Fishes, as specimens were recorded from a depth of 2500 fathoms. However, as mentioned there (p. 203), it is one of the most common of pelagic forms in the Atlantic as well as in the Indian Ocean, and, therefore, is caught on almost every voyage during which the tow-net is used. Also, the Challenger obtained a surface specimen near the west coast of Africa on April 28, 1876. The habits of this fish are nocturnal.

*Halaphya*, n. gen.

I propose this generic name for three specimens, 26 mm. long., and 1.5 mm. deep, which were obtained at the surface, in the open sea, on the passage from Sydney to Wellington. They are evidently the young, and probably a very early stage of growth, of a fish which shows some affinities to *Microstoma*. Costa (Faun. Regn. Napol. Pesc.) figures on pl. xl. fig. 4, a small fish which must have been very similar to *Halaphya*; but neither description nor name seem to have been published by him in explanation of the figure.

There is, however, another fish from the Southern Indo-Pacific, which has to be considered in determining the origin of these young specimens, viz., *Gonorhynchus*. The fishes of this genus are rather scarce, but extend from the Cape of Good Hope to New Zealand, and Japan. The form of the body, the position and shape of the fins, and even the number of fin-rays of *Halaphya* are remarkably like those of *Gonorhynchus*, but the form of the snout is entirely different. We should be obliged to assume that with advancing growth the upper jaw is produced into a long proboscis, at the end of which a barbel is developed. A change like this is not without parallel in the development of fishes, but without knowing any of the intermediate stages we should not be justified in assuming it in this case. Of the development of *Gonorhynchus* nothing whatever is known.

With the materials at present available the genus may be characterised as follows:—



Body elongate, rather compressed, naked, with black (phosphorescent) spots. Cleft of the mouth very small. Eye of moderate size. Dorsal fin short, opposite to the space between ventrals and anal; adipose fin none; anal short; caudal emarginate. Gill-openings wide.

An affinis *Microstomati*?

*Halaphya elongata*, n. sp. (Pl. VI. fig. C).

The general form of the body and the position of the fins will be seen from the figure. The specimens are perfectly transparent and of the same white colour which the *Leptocephali* assume after immersion in spirits. No scales can be discovered on any part of the body. A series of minute specks of black pigment runs along the intermuscular line of the side of the body, and similar specks occupy the upper and lower margins of the free portion of the tail. These pigment spots remind us of similar organs in the *Leptocephali*, and many young Scopelids. The snout is obtuse, with a narrow transverse anterior mouth. The gill-openings are wide, the gill-membrane being grown to the isthmus anteriorly for a short distance only. Pectorals well developed; ventrals shorter. A very distinct fold of the skin runs from the pectoral along the median line of the abdomen to the vent. Dorsal and anal fins of moderate height, with the rays well developed. D. 12. A. 9. Caudal emarginate behind.

*Prymnothonus* (Pl. V.).

In the Ichthyology of the Voyage of the "Erebus" and "Terror," Richardson figured a small fish which he named *Prymnothonus hookeri*, and which was known to him from a sketch only, drawn by Dr. Hooker from the fresh specimen. He could not add any further information, the notes made at the time by Dr. Hooker having been mislaid, but he says that the specimen measured  $1\frac{1}{4}$  inches in length. It had perished before the collection reached Sir John Richardson's hands. Although I applied again after the return of the Challenger for further information to Sir Joseph Hooker, he was unable to recollect any particulars as regards the capture of the specimen, or the circumstances under which it was obtained.

The Challenger collection contains three specimens which evidently belong to the same kind of larval form, for such *Prymnothonus* proves to be. These specimens are not in a good state of preservation, and as they are unique, only a portion of their structure can be ascertained.

The smallest of the specimens (Pl. V. fig. A), was obtained in the North Pacific, on

July 2, 1875, and is 12 mm. long and 1 mm. broad. It represents evidently a somewhat less advanced stage of the same group of fishes than the following. The snout is much distorted, but the general form and structure of its component parts were probably the same as in the next largest specimen, although rather shorter. The eye is extremely large and of an oval shape, occupying nearly the whole depth of the head. The termination of the tail is diphyccercal; the embryonic fin-fringe commences on the back as a transparent rayless membrane in about the middle of the length of the fish, the dorsal rays becoming a little more distinct further behind, all being much more feeble than those of the ventral side. The anal fin becomes distinct behind the middle of the length of the body, is higher than the dorsal, and after having proceeded for a short distance, the rays become abruptly longer, stronger, and more closely set, and are supported by hæmal elements nearly to the end of the chorda. The situation of the vent, and the position of the paired fins, if they be present, cannot be ascertained.

The second specimen (Pl. V. fig. B) is 14 mm. long, and was obtained on May 3, 1876, on the surface of the North Atlantic. It is elongate, band-shaped, with pointed, subconical snout. The mandibulary and maxillary bones are long, and the cleft of the mouth extends to below the eye. Teeth, as represented by Richardson in *Prymnothonus*, cannot be detected in this specimen. The eye is large. The vent is clearly distinct at a distance from the head which is nearly equal to the length of the latter. Behind the vent a low embryonic fringe commences, which is continued round the tail, terminating on the back in about the middle of the length of the fish. The fringe is striated or rayed throughout, but the rays are exceedingly fine in the anterior half of the anal portion, become then suddenly longer and stronger, forming a kind of lobe, and are shorter again round the caudal extremity. The termination of the vertebral column is heterocercal, the end of the chorda being bent upwards and continued beyond a group of hæmal elements supporting an assemblage of stronger rays which in the adult fish would be developed into a distinct caudal fin. Of the paired fins the pectorals are clearly developed, but I cannot detect a trace of ventrals. Behind and above the pectorals a larger and two smaller roundish black spots are visible below the transparent integument, which are the liver and other abdominal organs. A similar black spot existed in the specimen of *Prymnothonus hookeri*, and was misunderstood by Richardson, who, having a drawing only for his description, considered it to represent the gill-opening. As far as I am able to judge from the specimen described here, the gill-opening is wide, and at its usual place.

The specimen of which Richardson (*loc. cit.*) has given a figure, reproduced here (Pl. V. fig. C), seems to have been intermediate, as regards development, between that just described and the third discovered by the Challenger. The termination of the tail is homocercal, with a distinctly differentiated caudal fin, which, however, is continuous with the dorsal and anal. The dorsal extends only a short way forward on the tail, but

the anal is continued as an even broad fringe to the vent. A dark shaded portion of this anal fin seems to indicate also, in this specimen, the presence of a permanent anal, the position of which corresponds closely to that of a similar structure in our first and in the following specimen. The vent is placed far forwards, at a distance from the head less than the length of the latter. Abdominal organs visible through the thin integument of the walls of the abdomen. Pectoral present. Eye of moderate size. Snout produced, with wide cleft of the mouth, which was armed with pointed teeth. This specimen was  $1\frac{1}{4}$  inches or about 32 mm. long; it was not preserved, nor is it known where it was caught.

The fourth specimen known of *Prymnothonus*, the third of the Challenger collection, is 44 mm. long, and was obtained on February 26, 1874, south-west of Kerguelen Island, in lat.  $62^{\circ} 26' S.$ , long.  $95^{\circ} 44' E.$ , in the dredge, which had reached the depth of 1975 fathoms. However, it is more probable that it entered the dredge near the surface, like the other specimens. The head and body are slender (Pl. V. fig. D), the greatest depth of the former being only 2 mm., and that of the middle of the body  $1\frac{1}{2}$  mm. The body is compressed, of a whitish colour, no muscular segmentation showing through the integuments. Only the tough wide sheath of the notochord remains, without a trace of ossification. Many of the cranial bones are distinctly ossified. Tail homocercal, with a well-formed bilobed caudal fin; at a distance of 6 mm. in front of the caudal a rayed anal fin commences, which, however, shows rays in the middle only, passing into the remains of the embryonic fin anteriorly and posteriorly; opposite to this anal, in front of the caudal, a dorsal fin is represented by a short strip of the embryonic fin-fringe.

The head is  $7\frac{1}{2}$  mm. long, with a prolonged, straight, pointed snout (4 mm.). The cleft of the mouth extends backwards to the eye; jaws armed with widely set, strong, acute teeth, unequal in size. Eye large, projecting. Pectoral fin small, but I have been unable to distinguish ventral fins or the position of the vent. The abdominal cavity seems to have been as long as the head. As in the other specimens, the dorsal and ventral muscles have not yet met in the median line of the side of the abdomen, so that the abdominal organs are covered by the integument only, through which the outlines of the stomach are clearly visible.

I have no doubt that all these specimens represent larval conditions of fishes belonging to *Paralepis* or *Sudis*, or of genera allied to them. That they all are stages of development of the same generic type of fishes is very improbable, but the second and third specimens may well be considered to be the same type, which provisionally may be designated by the name proposed for it by Richardson.

*Muraena* sp.

A specimen, 3 inches long, obtained at the surface between Tenerife and St. Thomas, West Indies, although very young, has all the characters of an adult fish, and no trace of Leptocephaloid structure. The species cannot be determined.

*Leptocephalus*, Gron.

Singularly, few specimens only were collected during the expedition; and these do not throw new light upon the question of their origin.

*a-f.* Obtained in Mid Atlantic on March 4, 1874. They belong to the form which has received the name "*pellucidus*," and other names. The specimens vary much with regard to the relative length of the body.

*g.* Off the west coast of Africa; lat. 10° 55' N., long. 17° 46' W.; April 13, 1876.

*a.* Obtained on the west coast of Africa; surface; August 16, 1873; form, "*Leptocephalus morrisii*."

*a.* Obtained near the Admiralty Islands, March 16, 1875; form, "*Leptocephalus tænia*."

*a.* North Atlantic; April 13, 1876; form, "*Leptocephalus brevirostris*."

## V. PLECTOGNATHS.

*Balistes* sp.

Three specimens, 5 lines long, from driftwood, north of Papua; February 21, 1875.

*Tetrodon* sp.

Two specimens,  $\frac{1}{3}$  inch long, at the surface, between Tenerife and St. Thomas, West Indies.

## VI. LEPTOCARDII.

*Branchiostoma*, Costa.

The littoral specimens of *Branchiostoma* collected during the voyage, belong to *Branchiostoma belcheri*, Gray, and *Branchiostoma cultellum*, Ptrs., and were obtained, the former at Samboangan, the latter on the north coast of Australia. They are mentioned here, because they were received too late to be introduced into the Report on the Shore Fishes.

Beside these species there is represented a third by a specimen labelled "Deep haul, 1000 fathoms. Pacific, July 26, 1875." On this date the Challenger was in lat.  $23^{\circ} 3'$  N., long.  $156^{\circ} 6'$  W., a few degrees north of Honolulu. This specimen, therefore, was captured in the open sea, at a great distance from land; but it would seem to be uncertain whether it came from that great depth or from the surface. On the one hand, as living specimens of *Branchiostoma* are always observed to sink to the bottom after some almost convulsive motions to wriggle themselves towards the surface, it is difficult to see how a Lancelet could maintain itself at the surface in the open ocean; on the other hand, the perfect condition of the delicate fin-fringe would suggest that the specimen could not have been hauled up from so great a depth, without showing signs of injury. However this may be, the specimen, although approaching in form, and in the number of myocommas, *Branchiostoma belcheri*, differs from it in the shape of the caudal fin, and especially from this and all the other species by the absence of buccal cirrhi.

*Branchiostoma pelagicum*, n. sp. (Pl. VI. fig. B).

The specimen is 10 mm. long and 1 mm. deep; it was mounted in glycerine for the microscope at the time of its capture.

The anterior end of the notochord is enveloped in a very strong sheath; the posterior ( $\frac{1}{2}$  mm.) is not covered by the myocommas, which leave off abruptly, and extends right to the hind margin of the caudal fin. Eye distinct; nerve-cord with minute pigment-spots arranged intracentrally with regard to the myocommas. Dorsal fin-rays low, but very distinct, about five to each myocomma. The dorsal fin-fringe commences to become distinct about the twenty-seventh myocomma, gradually becoming somewhat higher behind. Its rise is more abrupt where it passes into the caudal fin, which is paddle-shaped and bilaterally symmetrical with regard to the notochord. The lower half of the caudal passes uninterruptedly into the ventral, in which no rays are developed. This fin seems to be continued forward as a very low fringe for some distance beyond the supposed position of the atrial pore. Nearly the whole of this fringe shows a minute vertical striation, especially in its higher portions.

The number of myocommas is sixty-seven, of which fifteen belong to the tail. How many should be attributed to the portion between vent and atrial pore is uncertain on account of the difficulty in ascertaining the position of the latter. I have been unable to make out this pore, and infer its position to be opposite to the thirty-sixth myocomma only from analogy or comparison with other species, and from a slight contraction of the muscular layer at this spot.

Buccal tentacles are absent; this cannot be due to the age of the individual, as they

are clearly developed in specimens of *Branchiostoma belcheri* (?) of only half the size of this specimen.

Gonads not fully developed, extending from the first to the twenty-sixth myocomma, and forming two series in the middle. The atrial cavity extends somewhat behind the supposed position of the atrial pore.

## ALPHABETICAL INDEX.

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- Acanthopterygians*, 5.  
*acanthorhynchus* (*Hemerocætes*), 18.  
*acus* (*Fierasfer*), 27.  
*affinis* (*Exocoetus*), 37.  
*affinis* (*Thynnus*), 17.  
*albescens* (*Echeneis*), 18.  
*Anacanthus*, 20.  
*Antennarius*, 18.  
*arafurensis* (*Psenes*), 13.  
*Asthenurus*, 23.  
*Astronesthes*, 38.  
*atlanticus* (*Bregmaceros*), 24.  
*atripinnis* (*Asthenurus*), 23.  
*atripinnis* (*Bregmaceros*), 23.  
*Auchenoceros*, 24.  
*auratus* (*Psenes*), 12.  
*Balistes*, 42.  
*belcheri* (*Branchiostoma*), 42.  
*Belone*, 34.  
*bennettii* (*Centrolophus*), 10.  
*bipinnulatus* (*Seriolichthys*), 8.  
*brachysoma* (*Exocoetus*), 37.  
*Branchiostoma*, 42.  
*Bregmaceros*, 22.  
*brevirostris* (*Leptocephalus*), 42.  
*callopterus* (*Exocoetus*), 37.  
*Calloptilum*, 22.  
*caninianus* (*Scopelus*), 30.  
*capensis* (*Cubiceps*), 11.  
*Carcharias*, 5.  
*Centriscus*, 19.  
*Centrolophus*, 10.  
*Centrophilus*, 10.  
*cepedianus* (*Lophotes*), 19.  
*coccoi* (*Scopelus*), 30.  
*comatus* (*Exocoetus*), 36.  
*Coryphæna*, 9.  
*Couchia*, 20, 21.  
*Cubiceps*, 11, 12.  
*cultellum* (*Branchiostoma*), 42.  
*cyanophrys* (*Psenes*), 12.  
*Cybium*, 17.  
*Cyprinodonts*, 33.  
*dactyloptera* (*Scorpæna*), 6.  
*dentatus* (*Fierasfer*), 28.  
*Diagramma*, 11.  
*Diplophos*, 32.  
*Echeneis*, 18.  
*elongata* (*Halaphya*), 39.  
*elongatus* (*Lepidopus*), 7.  
*Encheliophis*, 28.  
*equisetis*, 9.  
*evolans* (*Exocoetus*), 35.  
*Exocoetus*, 34, 35.  
*ferox* (*Stomias*), 31, *note*.  
*Fierasfer*, 27.  
*Flying fish*, 35.  
*forsteri* (*Scombresox*), 34.  
*Fundulus*, 33.  
*fuscus* (*Pimelepterus*), 6.  
*Gastrochisma*, 15.  
*Gempylus*, 7.  
*germo* (*Orcynus*), 17.  
*glacialis* (*Scopelus*), 31.  
*gladius* (*Xiphias*), 6.  
*glauca* (*Lichia*), 9.  
*glaucus* (*Carcharias*), 5.  
*Gobius*, 19.  
*Gonorhynchus*, 38.  
*goreensis* (*Trachynotus*), 9.

- gracilis* (Centriscus), 19.  
*gracilis* (Cubiceps), 11.  
*gronovii* (Nomeus), 13.  
*Halaphya*, 38.  
*hectoris* (Scopelus), 31.  
*Hemerocoetes*, 18.  
*Hemirhamphus*, 34.  
*Hippurus*, 9.  
*Histiophorus*, 6.  
*Holocentrum*, 6.  
*hookeri* (Prymnothonus), 39.  
*huttonii* (Lepidothynnus), 15.  
*huttonii* (Platystethus), 13.  
*Hyperoglyphe*, 10.  
*javanicus* (Psenes), 12.  
*kröyeri* (Scopelus), 31.  
*lamia* (Carcharias), 5.  
*Lancelet*, 43.  
*Leirus*, 10.  
*Lepidopus*, 7.  
*Lepidothynnus*, 15.  
*Leptocardii*, 42.  
*Leptocephalus*, 29, 42.  
*leucurus* (Psenes), 12.  
*Lichia*, 9.  
*lineatus* (Exocoetus), 37.  
*Lirus*, 10.  
*Lophotes*, 19.  
*macclellandii* (Bregmaceros), 22, 25.  
*macroductylus* (Trigla), 18.  
*maculata* (Mene), 14.  
*maculatus* (Psenes), 11.  
*marmoratus* (Antennarius), 18.  
*medusophagus* (Schedophilus), 10.  
*Mene*, 14.  
*Microstoma*, 38.  
*mirum* (Calloptilum), 22, 25.  
*morrisii* (Leptocephalus), 42.  
*multiradiatus* (Cubiceps), 12.  
*Muraena*, 42.  
*myrias* (Trachynotus), 9.  
*naresii* (Exocoetus), 36.  
*naucrates* (Echeneis), 18.  
*Nealotus*, 6, 7.  
*niger* (Astronesthes), 38.  
*nigrofasciatus* (Fundulus), 33.  
*nigro-ocellatus* (Scopelus), 30.  
*Nomeus*, 13.  
*obscurus* (Carcharias), 5.  
*obtusirostris* (Exocoetus), 35.  
*Onus*, 20.  
*Orcynus*, 17.  
*pacificus* (Diplophos), 33.  
*Palinurichthys*, 10.  
*Palinurus*, 10.  
*Pammelas*, 10.  
*Paralepis*, 41.  
*paucidens* (Lirus), 11.  
*Physostomi*, 30.  
*pelagicum* (Branchiostoma), 43.  
*pellucidus* (Leptocephalus), 42.  
*perciformis* (Lirus), 10.  
*perciformis* (Pammelas), 10.  
*Pimelepterus*, 5.  
*Platystethus*, 13, 14.  
*Plectognaths*, 42.  
*Pleuronectidæ*, 28.  
*pompilus* (Centrolophus), 10.  
*Porobranchus*, 27.  
*porosa* (Diagramma), 11.  
*porosa* (Hyperoglyphe), 10.  
*porosus* (Lirus), 11.  
*Prionotus*, 19.  
*prometheus* (Thyrstites), 7.  
*Prymnothonus*, 39.  
*Psenes*, 11, 12.  
*punctatum* (Calloptilum), 23.  
*punctatus* (Auchenoceros), 26.  
*punctatus* (Bregmaceros), 26.  
*Raniceps*, 21.  
*reinhardtii* (Onus), 20.  
*remora* (Echeneis), 18.  
*rondeletii* (Exocoetus), 37.  
*Rudder fish*, 10.  
*saurus* (Scombresox), 34.  
*Schedophilus*, 10.  
*scolopax* (Centriscus), 19.  
*Scombresox*, 34.  
*Scopelus*, 30.  
*Scorpæna*, 6.  
*scoticus* (Scopelus), 31.  
*Seriola*, 8.  
*Seriolichthys*, 8.  
*Sharks*, 5.  
*simus* (Exocoetus), 37.  
*solandri* (Exocoetus), 35.  
*Solea*, 29.  
*Stomias*, 31, *note*.  
*Sudis*, 41.  
*Synaptura*, 29.



- |                            |                               |
|----------------------------|-------------------------------|
| tænia (Diplophos), 32.     | Trachynotus, 9.               |
| tænia (Leptocephalus), 42. | trifurcus (Raniceps), 21.     |
| tenuis (Encheliophis), 28. | Trigla, 18.                   |
| tenuis (Lepidopus), 7.     | tripes (Nealotus), 6.         |
| Tetrodon, 42.              | vadigo (Lichia), 9.           |
| thunnina (Thynnus), 17.    | Vexillifer, 27.               |
| Thynnus, 16, 17.           | waigiensis (Pimelepterus), 5. |
| Thyrsites, 7.              | Xiphias, 6.                   |

PLATE I.

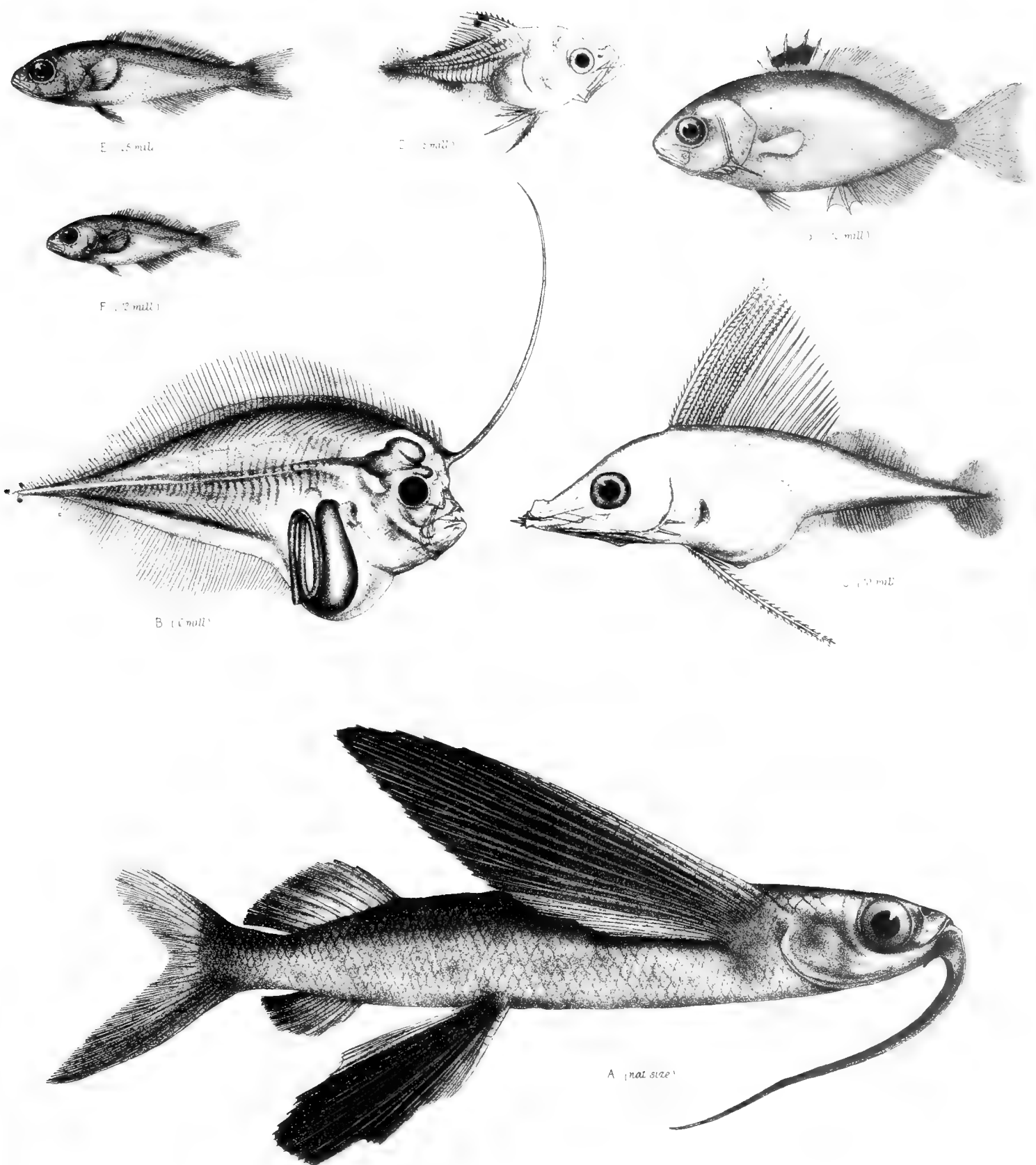
Fig. A. *Exocoetus naresii*, nat. size, off Cape York.

Fig. B. Young of Pleuronectoid, 6 mm. long, off coast of Sierra Leone.

Figs. C, D. *Thyrsites prometheus*, young, 5 and 10 mm. long, the former from south of Yeddo, the latter from north of the Sandwich Islands.

Figs. E, F. *Seriolichthys bipinnulatus*, young, 13 and 25 mm. long, north of New Guinea.

Fig. G. *Lichia glauca*, young, 10 mm. long, off west coast of Africa.



A EXOCOETUS NARES; B LARVAL PLEURONECTOID C & D LARVAE PROMETHEUS, young  
E & F SERIOLICHTHYS BIPINNULATUS, young G. LICHIA GLAUCIA, young

PLATE II.

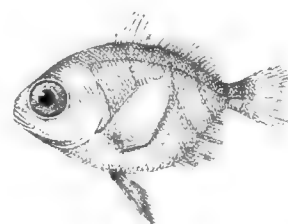
- Figs. A–C. *Cubiceps gracilis*, nat. size. A. from Madeira, B. from the Azores, C. from Messina.
- Fig. D. *Thynnus thunnina*, young, 17 mm. long, West Pacific.
- Fig. E. *Lirus paucidens*, 35 mm. long, West Pacific.
- Fig. F. *Lirus porosus*, head of a specimen 30 mm. long, off Kermadec Islands.
- Fig. G. *Psenes arafurensis*, nat. size, from the Arafura Sea.
- Fig. H. *Platystethus huttonii*, nat. size, New Zealand.
- Fig. I. *Platystethus huttonii*, young, 26 mm. long, South Pacific.
- Fig. K. *Lophotes cepedianus*, young, 11 mm. long, West Pacific.
- Fig. K'. Posterior end of the same, much enlarged. *c.* Caudal fringe; *a.* anal fringe; *pa.* præanal fringe; *v.* vent.


$$= \mathcal{M}^{\dagger} \mathcal{S}$$

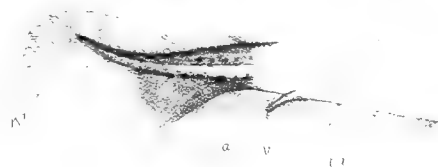
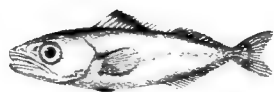
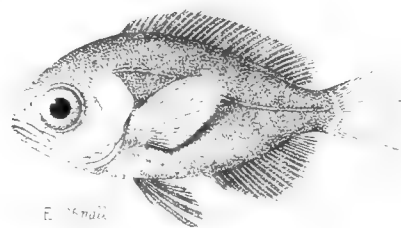

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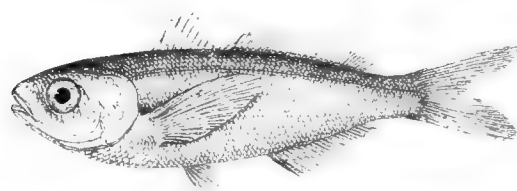
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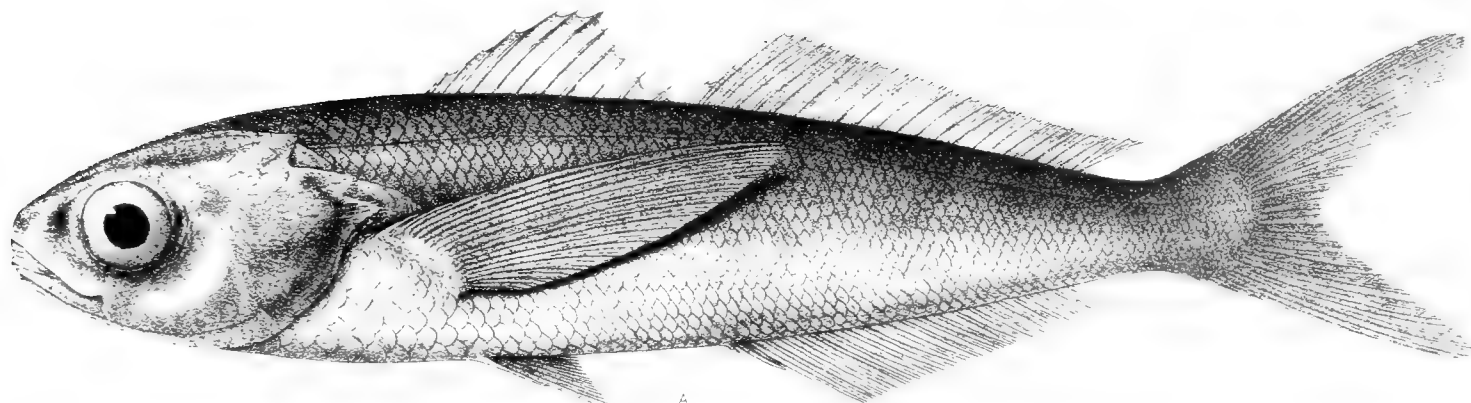
6.  $n_{\text{eff}}$


$$a \quad v$$

$$= \mathbb{M}_k(\mathbb{C})$$
 $t = 30 \text{ m di}$ 

E. 6.  $m_{\text{eff}}$



613



4

PLATE III.

Fig. A. *Bregmaceros maclellandii*, adult, nat. size, Indian Ocean. *a*. Lower view of thorax, to show arrangement of ventral rays ; *a'*. portion of long ventral ray, enlarged.

Fig. B. *Bregmaceros maclellandii*, young, 15 mm. long, Indian Archipelago.

Fig. C. *Auchenoceros punctatus*, adult, nat. size, New Zealand. *c*. Lower view of thorax, to show ventral fins.

Fig. D. *Auchenoceros* sp., young, 19 mm. long, Pacific.

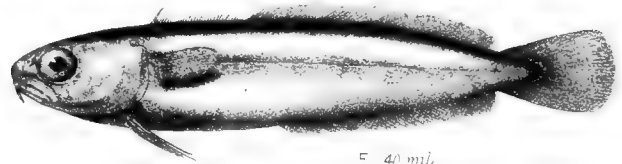
Fig. E. ?*Raniceps trifurcus*, young, 25 mm. long, North Atlantic.

Fig. F. *Onus reinhardtii*, young, 40 mm. long, Færoe Channel.

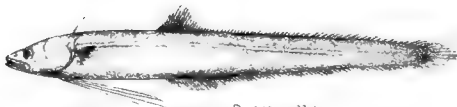
Fig. G. *Trigla macrodactylus*, young, 16 mm. long, off the coast of Sierra Leone.



E (25 mill)



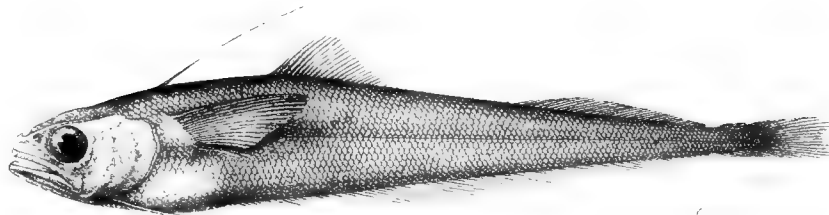
F (40 mil)



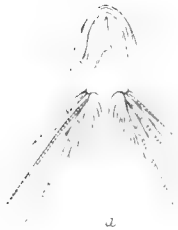
D (19 mill.)



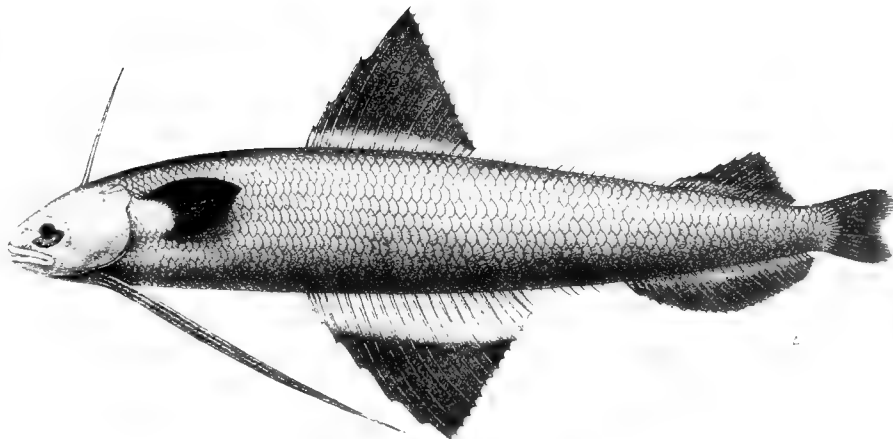
B (15 mill)



C



A



G



H

PLATE IV.

Fig. A. *Exocoetus solandri*, nat. size, East Africa, with lower view of snout to show barbels.

Fig. B. *Diplophos pacificus*, 37 mm. long, Mid Pacific.

Fig. C. *Diplophos tænia*, 38 mm. long, South Atlantic.

Fig. D. *Synaptura* sp., young,  $13\frac{1}{2}$  mm. long, West Pacific.

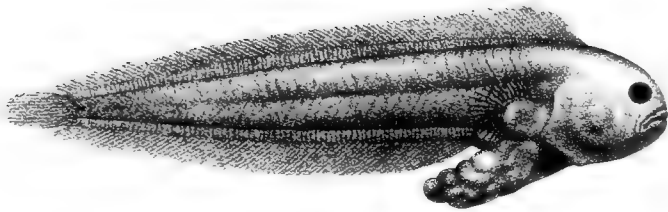
Fig. E. *Solea* sp., young,  $5\frac{1}{2}$  mm. long, off the mouth of the Plate River.

Fig. F. *Fierasfer acus*, young, 104 mm. long, Færoe Channel; with enlarged figure of anterior part of body.

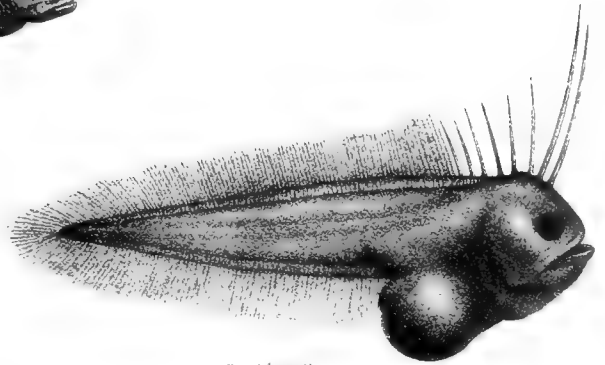




F. 104 mill.



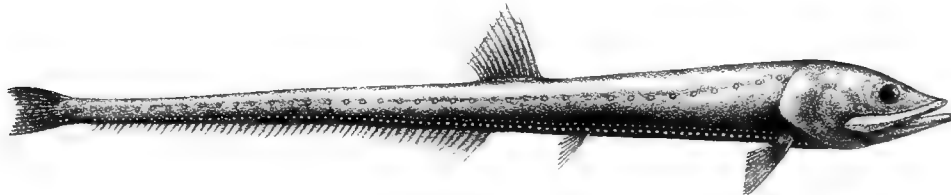
D. (13½ mill.)



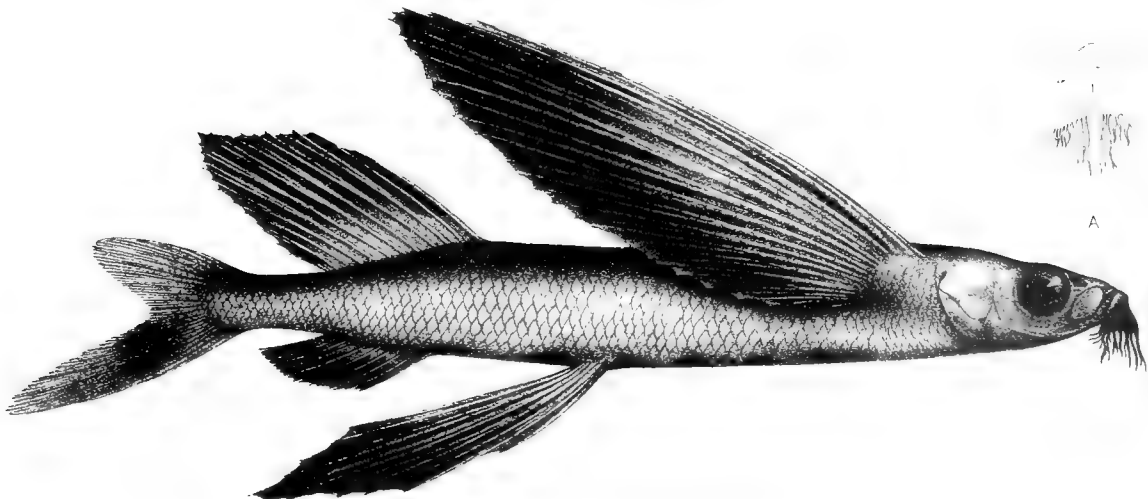
E. (5½ mill.)



C. (38 mill.)



B. (37 mill.)



A.

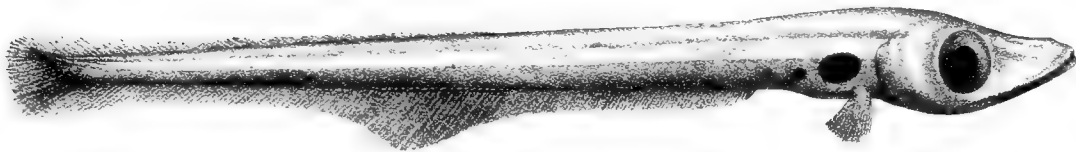
PLATE V.

Figs. A–D. *Prymnothonus*. A. 12 mm. long, North Pacific; B. 14 mm. long, North Atlantic; C. 32 mm. long, reproduced from Voy. Sulph. Ichthyol., place of capture unknown; D. 44 mm. long, with separate view of dentition, Antarctic.

Fig. E. Ovum of a Scombresocid,  $2\frac{1}{2}$  mm. in diameter Tropical Atlantic.



A (2 mill)



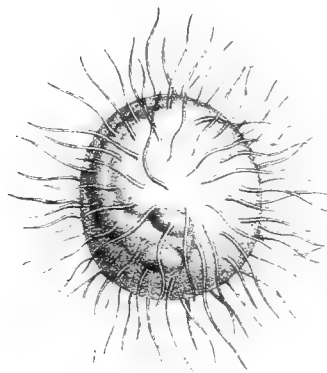
B (14 mill)



C (32 mill)



D (42 mill)



E (2.5 mill)

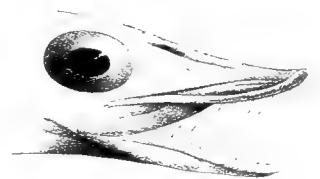


PLATE VI.

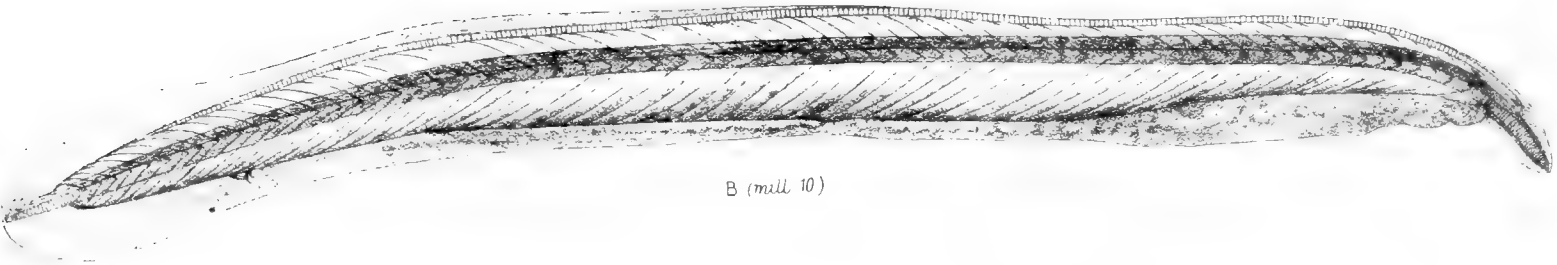
Figs. A, A'. *Lepidothyunnus huttonii*, reduced in size, New Zealand. A. from a sketch ;  
A'. skeleton, from a photograph ; *a*. scale, nat. size.

Fig. B. *Branchiostoma pelagicum*, 10 mm. long, Mid Pacific.

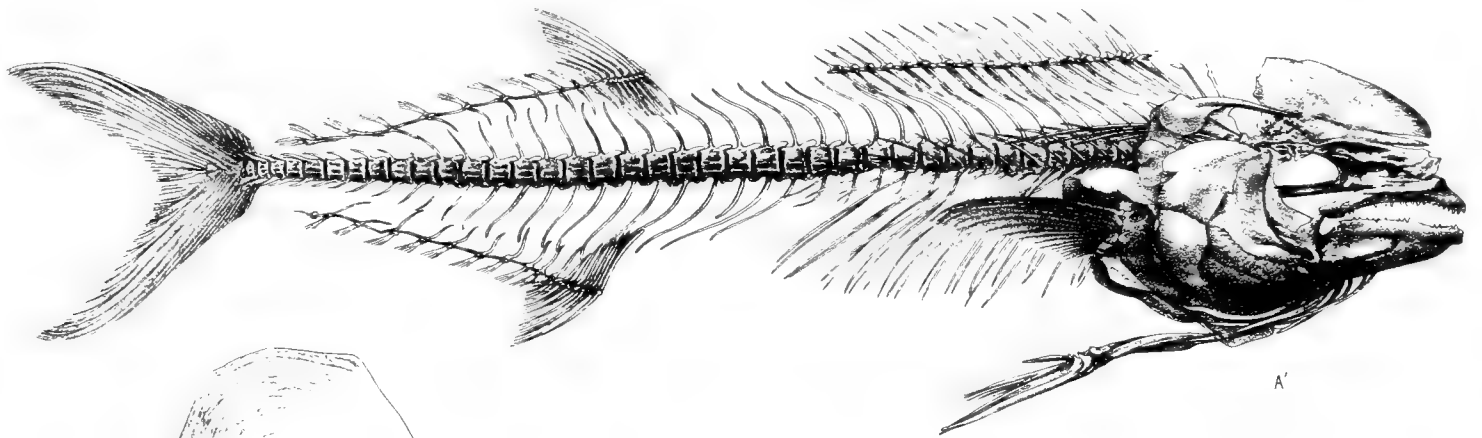
Fig. C. *Halaphya elongata*, 26 mm. long, South Pacific.



C (mill 26)



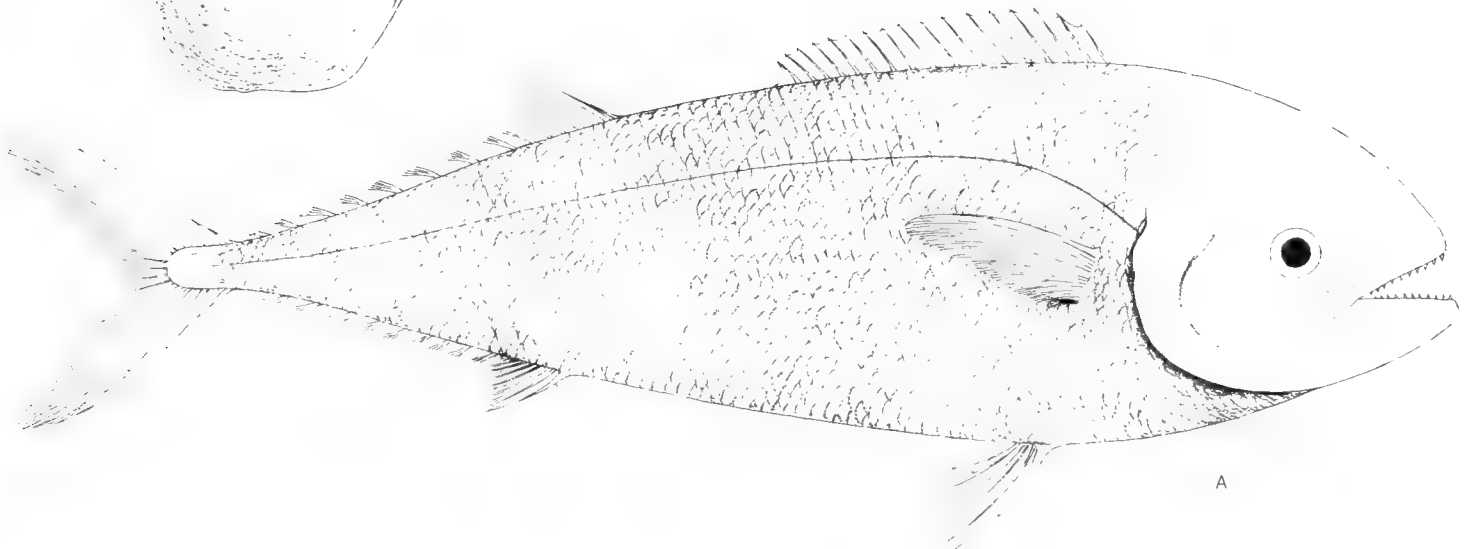
B (mill 10)



A'



a



A



THE  
VOYAGE OF H.M.S. CHALLENGER.

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ZOOLOGY.

---

SUPPLEMENTARY REPORT on the POLYZOA<sup>1</sup> collected by H.M.S.  
Challenger during the years 1873–1876. By ARTHUR W. WATERS,  
F.L.S., F.G.S.

INTRODUCTION.

SHORTLY after the death of Mr. George Busk, who prepared the Report on the Challenger Polyzoa, I had, through the kindness of his daughter, Miss Busk, an opportunity of examining some of the duplicate specimens, and I desire to thank her for sending me those which, from published criticism,<sup>2</sup> were most interesting to me. I have also to thank Mr. John Murray, the Director of the Challenger publications, for allowing me to examine the whole of the duplicate material in Edinburgh. I communicated to Mr. Murray some valuable results arising from an examination of sections of the Challenger specimens prepared by a method similar to that employed in the examination of fossil Polyzoa, and at his request I have drawn up the following supplementary notes on the Challenger species.

During my visits to the British Museum I was allowed to make a prolonged examination of the type collections. I am much indebted to Mr. Kirkpatrick, who has charge of these, for his assistance in looking at the type specimens when doubts or difficulties have since arisen during my absence from England.

The time allowed me for the preparation of these notes has been limited by Mr. Murray, and this must be my excuse for any shortcomings. Sections of decalcified portions have been made, but owing to want of time this method has not been used so

<sup>1</sup> The term Polyzoa is used for sake of uniformity.

<sup>2</sup> *Quart. Journ. Geol. Soc.*, vol. xli. p. 281, &c.

much as I could have liked; for the same reason several genera, as *Bugula*, and the whole Ctenostomata, have not been critically examined, and complete comparison with allied species in my collection has not been possible. However, I have been enabled to add particulars of various structures and organs not previously noticed. There is little doubt that Mr. Busk would have noticed many of these had he not been in very failing health during most of the time he was engaged in the preparation of his Report, which prevented him making full use of all the modern methods.

It will be best to give a short resumé of the points of chief interest dealt with in this Report, and I should place at the head the fact of a common parenchym cord surrounding the zoëcia of *Retepora columnifera* (Pl. III. fig. 10). This cord is no doubt the equivalent of what Joliet<sup>1</sup> calls the endosarc, but which Vigelius<sup>2</sup> would simply call the parenchym, and about which much has been written by Reichert, Claparède, Nitsche, Smitt, and others. In the Chilostomata, however, it has only been known inside the zoëcial cell or its connections, usually occurring near the walls, and communicating with the endosarc of the neighbouring zoëcia through the rosette plates. The position of this internal endosarc is variable, and changes at different stages of growth, so that sometimes a considerable accumulation is seen inside the walls of growing parts, and at others it is very difficult to trace it. This zoëcial parenchym occurs in a second *Retepora*, and will probably be found in others, thus opening a considerable field of investigation, and the question naturally arises as to whether the older forms had a zoarial endosarc; also speculation may be made as to its relationship with the chitinous cord of *Rhabdopleura*, and of the Gymnolæmata.

In several *Reteporæ* and some other genera there is a gland-like sac attached at each side of the oral aperture (Pl. III. figs. 12, 13), and in the avicularian chamber of *Lepralia margaritifera* there are two double gland- or sac-like bodies, which may have the same function or origin as those in *Retepora*. The late Dr. Joliet described an organ in *Pedicellina* as "organe segmentaire," and thought it was homologous with the intertentacular organ of Farre, Hincks, and Smitt; from his short description I do not see the ground for this, but think it should be studied together with the organs just mentioned.

In papers referred to elsewhere I called attention to the genus *Adeonella*, containing forms in which characters of primary importance are different. Mr. Hincks<sup>3</sup> refers in some detail to this, and in the main points agrees with me, but thinks that I have placed in the restricted genus some species which should be removed; but now that I have had an opportunity of examining all, they seem to form a natural group with some characters of *Adeona* on the one side, and of *Schizoporella* on the other. Although there is much that is

<sup>1</sup> L'Histoire naturelle des Bryozoaires des Cotes de France, *Archives de Zool. expér.*, tom. vi.

<sup>2</sup> Die Bryozoen gesammelt während der dritten und vierten Polarfahrt des "Willem Barents," p. 23, &c.

<sup>3</sup> Critical Notes on the Polyzoa, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xix. p. 150.



not understood, it seems that all in the group have small zoëcia, a bridge over the aperture ultimately forming a peristomial pore, the proximal edge of the operculum either in the form of a sinus or a wide curve; the avicularian mandibles similar, and of a type that we may call Membraniporidan; long pore tubes forming the connection both to the exterior and to the neighbouring zoëcia, in much the same way as in *Porina coronata*.

Besides the zoëcial and peristomial pores already alluded to, the pore on the front of the zoëcium may open into a separate chamber (Pl. I. fig. 5). This I first noticed in *Onchopora sinclairii*, and confirmed it by means of decalcified sections, and then found the same occurred in a few cases of allied forms. This should be studied in living specimens as the signification is not entirely clear, and it would be well to know how far post-mortem changes alter the appearance.

The signification of the "foramina," or, as it should be called, the socket of the operculum, of *Cellaria*, is now explained for the first time, and sections have thrown an entirely new light upon the *Myriozoum immersum* of Busk, in which the Schizoporelidan oral aperture is nearly at right angles to the axis of the zoarium, and thus can never be seen except when dissected either by section or decalcification, so that what Mr. Busk described as the oral aperture was only a cross section of the peristomial tube.

The structure of the ovicell of *Schizoporella* (*Gephyrophora*) *polymorpha*, Busk, is as far as I am aware unique, and is very instructive.

Three species that I came across I have been unable to identify, and consider new; besides which, fourteen additional known species are recorded, and in a few cases additions are made to the habitat. Ovicells have been seen in twenty-two cases where they were unrecognised, and the form of these and other structures has sometimes made it apparent that the generic or specific position must be altered. In many cases, however, Busk's names are used without wishing to indicate that the forms in question have found their permanent place.

Much has lately been written about classification, and some very unfortunate and premature attempts have been made at remodelling; established genera have been rechristened, and generic names given where it has been doubtful if specific were required. However, when these heroic attempts are made without facts to bear them out, they are usually ignored, and so bring their own punishment. As to my own position, I have repeatedly stated that, as far as the Chilostomata are concerned, I consider an immense advance was made when the zoëcial characters were put in the first rank, and believe that we are upon the right track; but none of us can suppose that there will not be much to alter as new facts are brought to light. We must not be satisfied merely with the shape of the operculum, but we must give special attention to the way in which it is attached and articulated, also the connection through the rosette plates<sup>1</sup> must be more studied; fortunately many of these characters can be deciphered in dry specimens,

<sup>1</sup> See *Thalamoporella labatia*, p. 13.

thus making it possible to learn much about the anatomy of fossils. It has always seemed to me that too much importance is now attached to peristomial characters, and there are several genera which clearly require modification, so that shortly revision of groups may be made by competent observers, but I do not think important results will be obtained by an attack along the whole line.

The genus *Membranipora* is now one of the largest, and no doubt contains many forms which should be removed, but it does not seem that Mr. Busk has been successful in his attempt to dismember it, since *Foveolaria elliptica* and *Foveolaria tubigera* are placed together in a new genus, and distinctive characters seem difficult to find for the groups which Mr. Busk called *Amphiblestrum*, *Foveolaria*, and *Biflustra*. Also *Membranipora galeata*, Busk, *Membranipora cervicornis*, Busk, and *Membranipora* (*Amphiblestrum*) *cristata*, Busk, are evidently very closely allied, and show that any classification placing them in different genera must be artificial.

In the paper already referred to, several points raised in Mr. Busk's Report were considered, and others were dealt with in a paper On the Use of the Avicularian Mandible,<sup>1</sup> &c., where I showed that "the articular process at each end of the base" of the mandible in the family Adeoneæ is not confined to that family, as supposed, but also occurs in *Membranipora*, *Cribrilina*, *Flustra*, &c. The so-called "columella" in the mandibles of certain *Celleporæ* I also showed was not distinctive of one division of *Cellepora*, or of those in the Southern hemisphere, but occurs in several European ones, and to this columella muscles are attached. In the mandibles of one *Cellepora*, called *Cellepora celosia* (in MSS.) by Busk, I find there are two columellæ, and in some species of *Diachoris* there are also two. A slight correction as to the operculum of *Schizoporella circinata* (MacGillivray) was made when describing the fossil form.<sup>2</sup> The opercula and mandibles of a few more species are now figured, and these chitinous appendages, which I was the first to use, are constantly of the greatest diagnostic value.

In the Journal of the Linnean Society, vol. xx. p. 275, I have dealt at some length with *Hornera* (*Idmonea*) *fissurata*, and hope shortly to describe *Cellepora columnaris* more fully from a fine New South Wales specimen, and also, in some journal or periodical, to give a fresh figure of *Supercytis tubigera*, as the series on the left-hand side are double, instead of single, and the ovicell is flattened on the front and surrounded with zoœcia.<sup>3</sup> There are also some species not yet recognised, and questions not completely studied, which have to be dealt with in subsequent papers.

Except where the contrary is indicated, it may be taken that I found the specific determination made, and, I presume, in every case by Mr. Busk.

<sup>1</sup> *Journ. Micr. Soc.*, ser. 2, vol. v. p. 774.

<sup>2</sup> *Quart. Journ. Geol. Soc.*, vol. xliii. p. 64. pl. viii. fig. 41.

<sup>3</sup> When describing the New Zealand fossil, *Supercytis digitata*, B. (*Quart. Journ. Geol. Soc.*, vol. xliii. p. 345), I made an unfortunate mistake in considering it had been found in Victoria, instead of South Australia.

Mr. J. R. Y. Goldstein<sup>1</sup> has described *Alysidium inornata* and *Hornera subdubia* from the Challenger dredgings, but neither are referred to by Mr. Busk. As to the second, it has seemed to me that it may be *Hydrocorallina*.

The Chilostomata were described by Mr. Busk in Vol. X. of the Challenger Reports (Zool. Chall. Exp., part xxx., 1884), and the Cyclostomata in Vol. XVII. (Zool. Chall. Exp., part l., 1886).

It will, of course, be understood that I have had in many cases but small pieces from which to make out the structure, and I am sure that any one undertaking re-examination may still find many new facts in the Challenger collections.

<sup>1</sup> Some new species of Bryozoa from the Marion Islands (*Trans. Roy. Soc. of Victoria*, 1881).



# LIST OF SPECIES REFERRED TO IN THIS REPORT.

	PAGE		PAGE
<i>Idmonea fissurata</i> , Busk, . . . . .	4	<i>Turritigera stellata</i> , Busk, . . . . .	22
<i>Supercytis tubigera</i> , Busk, . . . . .	4	<i>Cribrilina latimarginata</i> , Busk, . . . . .	22
<i>Alysidium inornata</i> , Goldstein, . . . . .	5	<i>Diporula hastigera</i> , Busk, . . . . .	23
<i>Hornera subdubia</i> , Goldstein, . . . . .	5	<i>Microporella distoma</i> , Busk, . . . . .	23
<i>Catenaria bicornis</i> , Busk, . . . . .	9	<i>Mucronella canalifera</i> , Busk, . . . . .	24
<i>Scrupocellaria marsupiata</i> , Jullien, . . . . .	9	<i>contorta</i> , Busk, . . . . .	24
<i>Urceolipora nana</i> , MacGillivray, . . . . .	9	<i>Bracebridgia geometrica</i> , Reuss, . . . . .	24
<i>Ichthyaria oculata</i> , Busk, . . . . .	10	<i>Smittia delicatula</i> , Busk, . . . . .	25
<i>Flustra cribriformis</i> , Busk, . . . . .	10	<i>smittiana</i> , Busk, . . . . .	25
<i>Monoporella (?) capensis</i> , Busk, . . . . .	10	<i>Lepralia mucronata</i> , Smitt, . . . . .	26
<i>Foveolaria (?) elliptica</i> , Busk, . . . . .	11	<i>occlusa</i> , Busk, . . . . .	26
<i>Membranipora fulcifera</i> , Busk, . . . . .	11	<i>japonica</i> , Busk, . . . . .	26
<i>dumerilii</i> , Audouin, . . . . .	12	<i>margaritifera</i> , Quoy and Gaimard, . . . . .	26
<i>umbonata</i> , Busk, var. nov., . . . . .	12	<i>lonchæa</i> , Busk, . . . . .	28
<i>galeata</i> , var. <i>furcata</i> , Busk, . . . . .	12	<i>castanea</i> , Busk, . . . . .	28
<i>Electra cylindracea</i> , Busk, . . . . .	12	<i>Aspidostoma gigantea</i> , Busk, . . . . .	28
<i>Thalamoporella steganoporoides</i> , Goldstein, . . . . .	13	<i>Hippothoa divaricata</i> , Lamouroux, . . . . .	29
<i>labiata</i> , Busk, . . . . .	13	<i>Schizoporella tenuis</i> , Busk, . . . . .	29
<i>Bifazaria submucronata</i> , Busk, . . . . .	14	<i>polymorpha</i> , Busk, . . . . .	29
<i>corrugata</i> , Busk, . . . . .	15	<i>challengeria</i> , n. n., . . . . .	30
<i>denticulata</i> , Busk, . . . . .	15	<i>vitrea</i> , MacGillivray, . . . . .	30
<i>Cellaria australis</i> , MacGillivray, . . . . .	16	<i>Myrionozoum marionense</i> , Busk, . . . . .	30
<i>rigida</i> , MacGillivray, . . . . .	16	<i>Hastellia (?) auriculata</i> , Busk, . . . . .	31
<i>Melicerita atlantica</i> , Busk, . . . . .	17	<i>Porina coronata</i> , Reuss, var. <i>labrosa</i> , Reuss, . . . . .	32
<i>dubia</i> , Busk, . . . . .	17	<i>Adeonella polymorpha</i> , Busk, . . . . .	32
<i>Calicellia sinclairii</i> , Busk, . . . . .	17	<i>intricaria</i> , Busk, . . . . .	33
<i>Retepora tessellata</i> , Hincks, var. <i>imperati</i> , Busk, . . . . .	18	<i>atlantica</i> , Busk, . . . . .	33
<i>gigantea</i> , Busk, . . . . .	19	<i>(?) regularis</i> , Busk, . . . . .	34
<i>lata</i> , Busk, . . . . .	19	<i>Cellepora pustulata</i> , Busk, . . . . .	34
<i>porcellana</i> , MacGillivray, . . . . .	19	<i>ansata</i> , Busk, . . . . .	34
<i>atlantica</i> , Busk, . . . . .	20	<i>megasoma</i> , MacGillivray, . . . . .	35
<i>monilifera</i> , MacGillivray, form <i>munita</i> , Hincks, . . . . .	20	<i>pumicosa</i> , Busk, var. <i>patonensis</i> , Busk, . . . . .	35
,, form <i>umbonata</i> , MacGillivray, . . . . .	20	<i>bicornis</i> , Busk, . . . . .	35
<i>contortuplicata</i> , Busk, . . . . .	20	<i>conica</i> , Busk, . . . . .	35
<i>columnifera</i> , Busk, . . . . .	20	<i>armata</i> , Hincks, var. <i>erecta</i> , nov., . . . . .	36
<i>avicularis</i> , MacGillivray, . . . . .	21	<i>honoluluensis</i> , Busk, . . . . .	36
<i>magellensis</i> , Busk, . . . . .	22	<i>mamillata</i> , var. <i>atlantica</i> , Busk, . . . . .	36

	PAGE		PAGE
<i>Cellepora bilabiata</i> , Busk, . . . . .	36	<i>Mustigophora hyndmanni</i> , Johnston, . . . . .	39
<i>Palmicellaria skenei</i> , Ellis and Solander, . . . . .	36	<i>Micropora coreacea</i> , Esper, . . . . .	39
<i>Cupularia canariensis</i> , Busk, . . . . .	36	<i>Lepralia pertusa</i> , Esper, . . . . .	39
<i>Selenaria maculata</i> , Busk, . . . . .	37	<i>Schizoporella auriculata</i> , Hassall, . . . . .	39
<i>Farciminaria biseriata</i> , n. sp., . . . . .	38	<i>Cellepora costazii</i> , Audouin, . . . . .	39
<i>Flustra separata</i> , n. sp., . . . . .	38	<i>Entalophora clavata</i> , Busk, . . . . .	39
<i>Porina proboscidea</i> , n. sp., . . . . .	39	<i>Escharoides verruculata</i> , Busk, . . . . .	39
<i>Lepralia bisinuata</i> , Busk, . . . . .	39	<i>Cribrilina monoceros</i> , Busk, . . . . .	40
<i>Schizoporella jacksoniensis</i> , Busk, . . . . .	39	<i>Fron dipora verrucosa</i> , Lamouroux, . . . . .	40
<i>Microporella coscinopora</i> , var. <i>armata</i> , Waters, . . . . .	39	<i>Idmonea bifrons</i> , Waters, . . . . .	40
<i>Schizoporella</i> (?) <i>woosteri</i> , MacGillivray, . . . . .	39	<i>Defrancia striatula</i> , Busk, . . . . .	41
<i>Mucronella tricuspis</i> , Hincks, . . . . .	39	<i>Lichenopora holdsworthii</i> , Busk, . . . . .	41
<i>Chorizopora brongniartii</i> , Audouin, . . . . .	39	<i>Idmonea atlantica</i> , Forbes, . . . . .	41

## NOTES ON THE DESCRIPTIONS OF THE SPECIES.

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*Catenaria bicornis*, Busk (Pl. I. fig. 1).

*Catenaria bicornis*, Busk, Zool. Chall. Exp., part xxx. p. 14, pl. ii. fig. 2.

Below the oral aperture there is a median band of thicker deposit about the centre of the zoecium, turning to each side and again dividing. The perforations are placed somewhat irregularly all along the band, and there does not seem to be any pore with a different function to the others, as the term central pore might lead us to expect. There is also an elongate slit at right angles to the end of each band (see figure). The zoecia along the central line of the colony are about twice as long, and stouter than those branching off from it. This is slightly shown in Mr. Busk's figures, but is more marked in the specimen before me.

*Scrupocellaria marsupiata*, Jullien.

*Scrupocellaria marsupiata*, Jullien, Dragages du Travailleur, Bull. Soc. Zool. de France, tom. vii. p. 507 (sep. p. 10), pl. xiii. figs. 17, 20, 1882.

*Menipea clausa*, Busk, Zool. Chall. Exp., part xxx. p. 20, pl. iv. fig. 5.

Jullien finding a single dorsal vibraculum on the specimens he dredged, placed them under *Scrupocellaria*, and considers that this shows that *Menipea* and *Scrupocellaria* should be united. Not having Jullien's observation in my mind when looking through the British Museum specimens, no notes were taken relating to the dorsal surface, but I since wrote to Mr. Kirkpatrick calling his attention to Jullien's paper, and he answers that "on the dorsum of two cells of *Menipea clausa* are organs I take to be vibracula."

*Habitat*.—Station 70, 1675 fathoms. North-west of Spain, 2018 fathoms. Jullien says 2018 m.

*Urceolipora nana*, MacGillivray.

*Urceolipora nana*, MacGillivray, Trans. Roy. Soc. Vict., p. 2 (sep.), 1880; Zool. of Vict., dec. xi. p. 19, pl. cv. figs. 5, 7.

*Calymnophora lucida*, Busk, Zool. Chall. Exp., part xxx. p. 83, pl. xxxii. fig. 3.

Specimens in my possession leave no doubt as to the identity of MacGillivray's and Busk's species. Calcining shows that the wall of the ovicell is much more solid than

any other part. There seems to be considerable zoöcial differences between *Urceolipora nana* and *Urceolipora dentata*, making it doubtful whether they should be placed together, especially as the aperture is in the one case with a sinus, and in the other without.

*Habitat*.—Victoria; New South Wales.

*Ichthyaria oculata*, Busk (Pl. I. fig. 4).

*Ichthyaria oculata*, Busk, Zool. Chall. Exp., part xxx. p. 46, pl. xiii. fig. 7.

The ovicell consists of two very distinct layers, and the inner one is calcareous, and has an ornamentation of radiating lines, each of which is formed of what may be called fine rulings. At the side of the zoarium in the lower part there is a bundle of fine chitinous tubes, and from these chitinous radicals are given off. There is sometimes a pore on the front, though not median, which will be a cameral pore, and the species should probably be placed with *Calwellia*. The dividing membrane extends up to the pore by the side of the aperture.

*Flustra cribriformis*, Busk (Pl. I. fig. 10).

*Carbasea cribriformis*, Busk, Zool. Chall. Exp., part xxx. p. 58, pl. xxxiv. fig. 8.

In a paper on some Australian Bryozoa<sup>1</sup> I pointed out that a fine specimen in my possession has no radical tubes, and in those examined from Station 186, 8 fathoms, I did not see any, but the specimens from Station 188, 28 fathoms, have them abundantly. This radical tube is very wide and annulated, giving off numerous fine tubes, and it is these secondary tubes which attach themselves to the grains of sand or small shells. These secondary tubes are usually simple but sometimes divide. There is a good specimen in the British Museum from an Australian locality without these radical tubes.

*Monoporella* (?) *capensis*, Busk (Pl. II. figs. 16, 17; Pl. III. fig. 25).

*Amphiblestrum capense*, Busk, Zool. Chall. Exp., part xxx. p. 67, pl. xxiii. fig. 3.

*Monoporella capensis*, Waters, Quart. Journ. Geol. Soc., vol. xliii. p. 49.

A specimen sent to me from Simon's Bay is very interesting, as it throws light upon what I called strengthening plates in *Membranipora spinosa*, Quoy and Gaimard.<sup>2</sup> These plates form lateral chambers for the opercular muscles.

Similar chambers occur in *Membranipora spinosa*, Quoy and Gaimard, *Membranipora annulus*, Manzoni, *Membranipora cervicornis*, MacGillivray, but not so marked in *Membranipora annulus* and *Membranipora cervicornis* as in the other two.

<sup>1</sup> *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xx. p. 93.

<sup>2</sup> See *Quart. Journ. Geol. Soc.*, vol. xliii. p. 48, pl. viii. fig. 32.



Dr. Jullien<sup>1</sup> makes a genus *Chaperia* based on this character. He then says he does not understand the object of these plates, and asks if they can be connected with the ovicells. In his recent paper<sup>2</sup> he says that the plates are for the insertion of the muscles on both faces.

Of fossil forms *Cellepora odontophora*, Hagenow, *Flustrellaria incrassata*, d'Orbigny, have somewhat similar plates, and probably when looked for they will be found in other genera, but it does not seem that it is advisable to make a genus based merely on the presence of these plates.

There are two large distal rosette plates near the opercular wall of the zoecium, and numerous communication points are spread over these plates. I consider that the nature and position of these rosette plates is of the greatest value in systematic determination, but I do not find that they are always equally important generically, and, in fact, in *Membranipora spinosa* they are small and numerous along the middle of the wall, being exactly opposite in character to those of the present species, although, according to Jullien, they must both be united under *Chaperia* on account of the muscle plates.

*Foveolaria* (?) *elliptica*, Busk (Pl. III. fig. 19).

*Foveolaria elliptica*, Busk, Zool. Chall. Exp., part xxx. p. 68, pl. xxiii. fig. 5.

Perhaps this may have to be taken as the type of a genus *Foveolaria*, which would be largely represented in the cretaceous. The greater part of the opesia is closed by the operculum. There seems nothing to take hold of in the present definition of the genus since the zoarial form is various; then as to the aperture, it is also deeply imbedded in many of the *Membraniporidae*; and again the sessile avicularium of *Foveolaria falcifera* is similar to that of *Membranipora flemingii*, *Membranipora minax*, &c., and the operculum of *Foveolaria tubigera* and *Foveolaria falcifera* is of the ordinary *Membraniporidan* type.

The avicularian mandible is similar to that of *Membranipora tenuirostris*, Hincks.<sup>3</sup>

*Membranipora falcifera*, Busk.

*Foveolaria falcifera*, Busk, Zool. Chall. Exp., part xxx. p. 69, pl. xv. fig. 6.

The avicularian mandible is similar to that of *Membranipora angulosa*, and the small chitinous piece at each side of the base also occurs here.<sup>4</sup> In *Foveolaria tubigera*, Busk (*loc. cit.*, p. 68), the form of the zoecium and of the avicularian mandible is *Membraniporidan* (Pl. II. figs. 29, 30).

<sup>1</sup> Remarques sur quelques espèces de Bryoz. Cheil., *Bull. Soc. Zool. de France*, tom. vi. p. 1 (sep.), 1881.

<sup>2</sup> Bryozoaires, Mission du Cap Horn, *Bull. Soc. Zool. de France*, tom. ix. p. 61.

<sup>3</sup> See *Journ. Micr. Soc.*, ser. 2, vol. v., pl. xiv. fig. 41.

<sup>4</sup> See *Journ. Micr. Soc.*, ser. 2, vol. v., pl. xiv. fig. 42.

*Membranipora dumerilii*, Audouin.

A specimen, marked *Membranipora crassimarginata*, var. *incrustans*, has the zoœcia irregularly oval-shaped, with a small triangular avicularium above each zoœcium, resembling the figure I gave of *Membranipora dumerilii*,<sup>1</sup> but with the ovicells somewhat narrower. There do not seem to be any vicarious avicularia.

*Habitat*.—Station 135A, off Inaccessible Island, Tristan da Cunha, 75 fathoms.

*Membranipora umbonata*, Busk, var. nov. (Pl. I. fig. 21).

There is a specimen from Station 320, 600 fathoms, growing on *Ascidia meridionalis*, which, in the shape of the zoœcium, of the peculiar erect avicularium, and the two spines, corresponds with *Membranipora umbonata*; but the calcareous granulated surface and the small ovicell differ from the typical *Membranipora umbonata*.

A small specimen of *Membranipora*, named *Membranipora galeata*, var. *furcata*, from off Marion Island, does not seem in any particular to differ from *Membranipora cervicornis*.

*Electra cylindracea*, Busk (Pl. I. figs. 13, 14; Pl. III. fig. 23).

*Electra cylindracea*, Busk, Zool. Chall. Exp., part xxx. p. 78, pl. xxxiii. fig. 2.

I was unable to understand this species from the description and figure, and it is clear that the characters were not quite correctly appreciated. The large avicularia at the base of the zoœcia form a wide tubular chamber, from the walls of which grow hollow calcareous cervicorne spines. To some avicularia there are as many as twelve such spines, and Mr. Busk mistook these for "furcate chitinous processes," which he thought grew from the base of the avicularium. The "clavate curved spines or horns" are curved in two planes, so that it would be impossible to give a satisfactory figure. The same is true (as already expressed by Mr. Busk) for the surface of the zoœcia, which is very much involved in consequence of the numerous raised spines at various levels. I have nevertheless tried to give a figure, which, in supplementing those already published, may enable the structure to be understood. It is, however, not characteristic in one particular, as the zoœcia are not usually immediately above those of the inferior row, but alternate or rather verticillate.

There are rosette plates on the opercular side of the distal wall.

It does not now fully correspond with the description of the family Electrinidæ, whereas it certainly seems to fall into the family Membraniporidæ, whether we retain a genus *Electra* or not; but as it is now seen to belong to the same group of the Membrani-

<sup>1</sup> *Quart. Journ. Geol. Soc.*, vol. xliii. pl. vi. fig. 4.

poridæ as *Amphiblestrum cristatum*, it would appear best to retain both in *Membranipora* until generic characters can be found for the group. *Membranipora tripunctata*, Waters,<sup>1</sup> belongs to the same group.

*Thalamoporella steganoporoides*, Goldstein (Pl. I. fig. 15).

*Vincularia steganoporoides*, Goldstein, Proc. Roy. Soc. Victoria, p. 6 (sep.) pl. ii. fig. 5, 1881.

*Vincularia gothica*, Busk, Zool. Chall. Exp., part xxx. p. 72, pl. xxiii. fig. 1.

Two out of four Challenger specimens have a small triangular avicularium at one of the lower corners of the zoæcium. In some parts these avicularia are fairly abundant, in others rare. The central arch or lip is formed, as described by Busk, through the coalescence of the basal and two lateral growths, but even when fully matured parts are calcined sutures are seen between the three processes.

The *Vincularia gothica*, d'Orbigny, is much smaller than the Challenger form, and it would be impossible from the description and figure to say whether it represents *Vincularia labiata* or *Vincularia gothica* of Busk, even if it be identical with either. *Membranipora gothica*, Busk,<sup>2</sup> cannot be the same as the present species on account of the different type of avicularia, and there is also the *Cellepora gothica* of Hagenow, so that it will be safer at present to retain Goldstein's specific name.

*Thalamoporella labiata*, Busk (Pl. I. fig. 23; Pl. II. figs. 12-15, 33).

*Vincularia labiata*, Busk, Zool. Chall. Exp., part xxx. p. 73, woodcut, fig. 3.

Sections prepared show the rosette plates with a very large watchglass-shaped calcareous protection on the one side. In my description of *Chorizopora brongniartii*,<sup>3</sup> I mentioned that the connecting tubes terminate with a convex end in the upper part of the zoæcia, but concave on the lower. Since then Vigelius<sup>4</sup> has figured these "halbkugelförmige Ausbuchtungen" in *Flustra*, and Levinsen<sup>5</sup> also gives a diagram, confirming what I have written as to the value of the characters which these rosette plates furnish in specific determination.

Dr. Jullien<sup>6</sup> proposes a new name "origella" for all "les bourgeons de l'endocyste," and divides them into "origelles evolutives," represented by the growths from the various rosette plates, and into "origelles abortives," representing the surface pores, and other perforations, and would like to see classification largely based upon what he calls the origella.

<sup>1</sup> *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xx. p. 184, pl. v. figs. 12, 18, 19, 20.

<sup>2</sup> *Quart. Journ. Micr. Sci.*, vol. iv. p. 176, pl. vii. figs. 5, 6, 7.

<sup>3</sup> *Ann. and Mag. Nat. Hist.*, ser. 5, vol. iii. p. 35.

<sup>4</sup> Die Bryozoen gesammelt während der dritten und vierten Polarfahrt des "Willem Barents," p. 21, &c.

<sup>5</sup> Bryozoer fra Kara Havet, 1886.

<sup>6</sup> Bryozoaires, Mission du Cap Horn, *loc. cit.*, p. 12.

I cannot accept Dr. Jullien's name *origella*, as I consider that he uses it for two things physiologically quite distinct, for to the rosette plates pass thin protoplasmic threads, whereas the tube pores contain a fluid with corpuscles.

With regard to the importance of "origelles evolutives" represented by the rosette plates, I am at one with Dr. Jullien, and have mentioned and figured many, both recent and fossil in my various papers, and do not consider a species is completely described until they are given. It of course often happens, especially with palæontological work, that there is not material available or in a state of preservation to admit of complete description. I have, however, made preparations of many hundred species, and find that besides the number of plates on both the lateral and distal walls, the position and shape is of value. They may be surrounded by a ridge or band, and in the plate there may be one or many points of communication. In some cases they occur in a rather long tube leading from one zoecium to another, as, for instance, in the distal rosette plates of *Porella cervicornis*, Ellis and Solander, but I have not before come upon any with such a large projecting cover as in *Vincularia labiata*. The character of these plates should be used with others, and not overrun, and by making us more sure of our species may indirectly help us with genera, and in some cases may be generically important, but not in all.

The lip rises up to the level of the operculum which rests upon it, thus forming a Microporidan aperture, and I should prefer to call it *Micropora*, but as I suppose Mr. Hincks would place it under *Thalamoporella*, I provisionally follow him.

Besides the lip, which projects upwards, the front wall of the zoecium is directed downwards (Pl. II. fig. 33), thus contracting the zoecium near the aperture; in *Stegano-porella neozelanica* the front wall turns some distance down into the zoecial chamber, which has been described as divided into two chambers, but in this last species the calcareous wall again turns up to the base of the oral aperture enclosing an empty space between the fold (Pl. II. fig. 32). In *Micropora impressa*, Moll., the spaces forming the so-called pores project into the zoecial chamber, causing a contraction at each side, but no median contraction as in the other two (Pl. II. fig. 34).

*Bifaxaria submucronata*, Busk (Pl. I. fig. 6; Pl. III. fig. 18).

*Bifaxaria submucronata*, Busk, Zool. Chall. Exp., part xxx. p. 80, pl. xiii. fig. 1.

A specimen sent to me from Station 122, 350 fathoms, has immersed ovicells, occurring as simple enlargements of the zoecia. In pieces calcined the zoecia somewhat separate, and then it is seen that the avicularium is at the base of the zoarium with a corresponding notch in the peristome of the zoecium below. Mr. Busk describes the zoecia as subcarinate, but this is from a deceptive appearance caused by the contraction of the outer membrane in drying.

I use the name *Bifaxaria* merely to indicate the species examined, but do not think

the genus will stand as at present defined, for the difference between this and *Bifaxaria lævis* seems very great, while perhaps some of the species should be added to *Urceolipora*, MacGillivray.

*Bifaxaria corrugata*, Busk (Pl. I. figs. 7, 8).

*Bifaxaria corrugata*, Busk, Zool. Chall. Exp., part xxx. p. 80, pl. xiii. fig. 3; pl. xxiv. fig. 6.

The avicularia, which are larger than indicated by Busk, belong to the zoarium above, as may be distinctly seen when calcined, since the zoecia then separate, with the avicularia remaining at the base. There are a few large pores on the surface of the zoarium. The ovicells occur in the two opposite zoecia, and are formed by a swelling of the superjacent zoecia; on the front of the ovicell there is near the upper part a small area surrounded by a rim.

*Bifaxaria denticulata*, Busk (Pl. II. fig. 31).

*Bifaxaria denticulata*, Busk, Zool. Chall. Exp., part xxx. p. 82, pl. xxiv. fig. 3.

When a section is examined, a concealed ovicell just above the operculum is revealed. Zoarium rooted by numerous chitinous tubes.

### Genus *Cellaria*.

It would have been well if the name *Cellaria* had been dropped long ago, but it seems that we should now consider it as established, seeing that it has been used by Smitt, Hincks, and MacGillivray, and is, in fact, generally employed; and, as pointed out by Hincks, *Cellaria fistulosa* was made the type of Lamouroux.

Mr. Busk, however, having used *Salicornaria* in his earlier works, seems to have been unable to accept a change in his last. Jullien, in his recent paper, Bryozoaires, Mission du Cap Horn, argues against using the name *Salicornaria*, but this seems like slaying the slain, and instead proposes *Melicerita* of Milne-Edwards, a change with which I am unable to agree. Dr. Pergens,<sup>1</sup> on the other hand, unites with the genus *Cellaria* the genus *Tubucellaria*, but this differs entirely in the form of the aperture, also in the last having a suboral pore, and to me the two genera seem widely separated. In an earlier paper Dr. Pergens<sup>2</sup> calls some fossils, apparently with Membraniporidan character, *Cellaria*, but among others also cites *Cellaria schreibersii*, Rss., which however has a Schizoporellidan aperture.

The peculiar shape of the aperture of *Cellaria*, fitting on to the one or two pairs of teeth, seems to be a generic character of greatest value.

<sup>1</sup> Pliocene Bry. von. Rhodos, *Ann. k. k. Nat. Hof. Mus.*, Bd. ii. p. 12, 1887.

<sup>2</sup> Les Bryozoaires du Syst. Montien, par Meunier et Pergens, 1886 (see *Cellaria* Vandenbroeckii. pl. i. fig. 1).

*Cellaria australis*, MacGillivray (Pl. II. figs. 1-4).*Cellaria fistulosa*, var. *australis*, MacGillivray, Zool. of Vict., dec. v. p. 48.*Cellaria australis*, MacGillivray, Trans. Roy. Soc. Vict., vol. xxi. p. 93.*Salicornaria clavata*, Busk, Zool. Chall. Exp., part xxx. p. 88, pl. xii. fig. 8.*Cellaria fistulosa*, var. *australis*, Hincks, Ann. and Mag. Nat. Hist., ser. 5, vol. xiii. p. 368, pl. xiv. fig. 4.

This is a very distinctly marked species, with very characteristic opercula and mandibles, well described by MacGillivray, but Busk seems to have been unaware of his later and fuller descriptions, and only refers to the earlier one.

This, being a larger species than most of the *Cellariæ*, is more favourable for studying in cross section, and some sections prepared rewarded me by showing in the clearest manner the function of what Mr. Busk calls the "foramina" of the operculum. These, instead of being as Busk supposed conical projections, are hollow sockets into which the denticles of the proximal edge of the aperture articulate.

An operculum in transverse section is shown in fig. 2. What Busk calls the granulated band is much thicker than the rest of the operculum, whereas the upper part and the "foramina" are thin.

Having worked out the signification of the lower denticles, I naturally asked, what are we to understand by the upper denticles, which occur in a few species, as *Cellaria rigida*, MacGillivray, &c., but I have not been able as distinctly to follow out the working of these, though no doubt the "branched chitinous support" is connected with them. Thus we have correlated structures, and, seeing that various fossils have these two pairs of teeth, this is of considerable importance. In *Cellaria rigida* the proximal pair of teeth are at a higher level than the distal (see fig. 5). The shape of the cover to the ovicell would seem to be specifically important. From each zoöcial chamber of the *Cellaria* a long tube arises which expands into the chamber above, and from the middle of these tubes there is a connection, of course, through a rosette plate to the zoöcia on each side. In one of the Challenger specimens the connecting chitinous tubes of a new branch follow the lines of the border of the zoöcia transversely across the zoarium forming zigzag lines.

*Cellaria rigida*, MacGillivray (Pl. II. figs. 5-7).*Cellaria rigida*, MacGillivray, Trans. Roy. Soc. Vict., vol. xxi. p. 92, pl. i. figs. 1, 2.; Zool. of Vict., dec. xi. p. 17, pl. 105, fig. 1.*Salicornaria simplex*, Busk, Zool. Chall. Exp., part xxx. p. 88, pl. xxxiii. fig. 8.

I have already referred to the shape of the teeth and to the connection from cell to cell when discussing the last species.

*Melicerita atlantica*, Busk (Pl. II. fig. 18).

*Melicerita atlantica*, Busk, Zool. Chall. Exp., part xxx. p. 96, pl. xiv. fig. 1.

There is a thickening of the calcareous wall round the ovicellular opening. There is one large distal rosette plate near the base of the wall, and two large lateral rosette plates, thus giving connection to each of the neighbouring zoecia. This seems to be allied to several cretaceous fossils.

*Melicerita* (?) *dubia*, Busk (Pl. II. fig. 19 ; Pl. III. figs. 24 and 35).

*Melicerita dubia*, Busk, Zool. Chall. Exp., part xxx. p. 97, pl. xxxiii. fig. 10.

I certainly do not consider that this is *Melicerita*, but as it is difficult to say at present where it should be placed, it may be better merely to discuss it under Busk's name, though the name cannot be permanently retained, seeing that *Pustulopora dubia*, Hag., is probably *Melicerita*.

In a specimen in Edinburgh there are no avicularia, and I was only able to find two in the British Museum specimen. The operculum, which is of a Membraniporidan character, with a projecting edging over the upper part, is situated in the membrane covering the zoecium, and has not any direct connection with the calcareous wall. There is one rosette plate in the distal wall situated near the base, and one large lateral rosette plate.

This is an interesting specimen, as there are many fossils from the chalk of this type, but I have not yet been able to identify it with any. It is related to *Eschara cymodoce*, d'Orbigny,<sup>1</sup> but is larger; also to *Eschara drya*,<sup>2</sup> and to *Eschara cyclostoma*, Hagenow.<sup>3</sup>

*Calwellia sinclairii*, Busk (Pl. I. fig. 5).

*Onchophora sinclairii*, Busk, Zool. Chall. Exp., part xxx. p. 103, pl. x. fig. 4.

The "lunate pore" does not open into the zoecial cavity, but into a separate chamber. This was first perceived in the spirit specimens without making any preparations, but microtome sections showed that the thin membranous wall starts from just above the pore. The chamber is empty, and I have not found any muscles in it, whereas there are numerous muscles attached to the membrane enclosing the tentacles and stomach.

The signification of this chamber is not clear, and can only be completely studied in living specimens with the tentacles expanded; but we have now three kinds of pores on the front of the zoecia, viz., the peristomial, the suboral opening into the body cavity, and the present, which, until we understand its meaning, we may call a cameral pore.

<sup>1</sup> Pal. Fr., p. 156, pl. 674, figs. 10-13.

<sup>2</sup> *op. cit.*, p. 168, pl. 677, figs. 7-9.

<sup>3</sup> Bry. Maast. Kr., p. 75, pl. ix. figs. 7, 8; pl. xii. fig. 3.

A somewhat similar structure is described by Mr. Busk in *Siphonicytara*, and they should on this account be placed, at any rate, in the same family.

*Urceolipora dentata*, MacGillivray, has a similar structure, and so has *Calwellia bicornis*, so far as I can judge the latter from dried specimens, leading to the conclusion that the correlation of aperture, pores, and ovicell in these species, shows that too much importance has been attached to the form of growth.

As to *Flustra bombycina*, I am in doubt; but in the British Museum specimen there is a projecting tongue (fleshy?) projecting partly over the pore.

*Habitat*.—Add Station 150, 150 fathoms.

### Genus *Retepora*.

Since Mr. Busk's Report was written, a paper by MacGillivray, dealing with *Retepora*, has appeared in the Zool. of Victoria, decade x., and as both were in print about the same time, there is some overlapping; so that now several of the names used in the Report are changed, and probably others will be found to be only synonyms.

*Reteporæ* frequently require calcining to distinguish all the structure, and by this means round dorsal avicularia have been found on several species where they were said to be absent.

As far as I am aware, the embryology of *Retepora* has never been described, and as the genus is one presenting many peculiarities, an acquaintance with its earlier stages is much to be desired.

Mr. Kirkpatrick informs me that a specimen in the British Museum, named *Retepora græffei*, Kirchenpauer, is the *Retepora producta* of Busk. As this is probably from the Museum Godeffroy, it may be the type specimen, but as the description is insufficient the name must be dropped.

The gland-like sacks found at the two sides of the aperture in many *Reteporæ* are referred to when describing the avicularia of *Lepralia margaritifera*.

*Retepora tessellata*, Hincks, var. *imperati*, Busk (Pl. III. figs. 7, 8, 39).

*Retepora imperati*, Busk, Zool. Chall. Exp., part xxx. p. 110, pl. xxvi. fig. 9.

The operculum is quite similar to that of the typical *Retepora tessellata* from Australia, and I am in doubt as to whether they should be separated as varieties. In *Retepora imperati* the avicularian chamber is stouter than in *Retepora tessellata*, and there are none of the gigantic avicularia. In some parts of the zoarium the ovicell is almost entirely immersed. In both this and the typical *Retepora tessellata* there is a minute sinus in the oral aperture. There are numerous strong calcareous radical processes; but this is not at all uncommon in the *Reteporæ*, though *Retepora columnifera* of the Challenger seems to



have been separated on that account. These rooting processes are divided by vibices, and in each division thus formed there is usually a small triangular avicularium, and also a few large pores. In section this process is seen to be composed of large chambers, the avicularian muscles only occupying a small part. The structure of the radical process of *Retepora columnifera* is identical. I have not seen *Retepora imperati* from the Mediterranean, and if it had been common at Naples should have expected it to come into my hands.

*Retepora gigantea*, Busk (Pl. III. fig. 6).

*Retepora gigantea*, Busk, Zool. Chall. Exp., part xxx. p. 114, pl. xxvi. fig. 7.

The dorsal surface has numerous small semicircular avicularia, and there are also similar ones on the front.

*Retepora lata*, Busk (Pl. III. figs. 9, 40).

*Retepora lata*, Busk, Zool. Chall. Exp., part xxx. p. 115, pl. xxvii. fig. 1.

I have for some years possessed two large specimens of this from Algoa Bay, but could not decipher the structure, as calcareous growth seems to have taken place over the anterior surface, obliterating the characters. The opercula and mandibles at once prove it to be *Retepora lata*; besides which, the extremely small fenestræ are the same, and I have also been able to see an ovicell with the vertical fissure. Besides the anterior triangular avicularia, there are small oval ones; the dorsal surface is areolated, and sometimes throws out calcareous radical processes. Sections show that in the thick dorsal walls there are the numerous empty spaces mentioned (p. 21) as occurring commonly in *Retepora*.

*Retepora porcellana*, MacGillivray.

*Retepora porcellana*, MacGillivray, Trans. Roy. Soc. Vict., vol. ix., 1869, p. 140; *op. cit.*, vol. xix. p. 289, pl. ii. fig. 9; Zool. of Vict., dec. x. p. 15; pl. 94, fig. 8; pl. 95, figs. 1-6.

*Retepora robusta*, Hincks, Ann. and Mag. Nat. Hist., ser. 5, vol. i. p. 359, pl. xviii. figs. 9, 10.

*Retepora crassa*, Busk, Zool. Chall. Exp., part xxx. p. 115, pl. xxvi. fig. 10; pl. xxvii. fig. 3.

It would seem that the avicularia may be either oval or round, as in the Challenger specimens examined, Stations 161 and 162, 33 and 38 fathoms, they are oval; while in another specimen from Victoria they are usually round, and this is also the case in a fragment from off Green Point, New South Wales. There are usually two large pores or pits on the front of the zoecium, near the proximal end.

*Habitat*.—Victoria; New South Wales.

*Retepora atlantica*, Busk.

*Retepora atlantica*, Busk, Zool. Chall. Exp., part xxx. p. 116, pl. xxviii. fig. 1.

This, which I should prefer to call *Retepora marsupiata*, Smitt, has the pore placed higher up than in *Retepora fissa*, so that the characteristic groove is wanting, but the two are closely allied, and it would be well to group *Retepora atlantica*, *Retepora marsupiata*, *Retepora fissa*, &c., round *Retepora fissa*, in the same way that MacGillivray has made various varieties of *Retepora monilifera*. Many of the *Reteporæ* are specifically separated on very slight grounds.

On the dorsal surface of *Retepora atlantica* there are numerous apiculate avicularia, usually one to each vibicated area, and besides there are numerous small round avicularia.

This is abundant in the washings of the dredge between Fayal and Pico.

*Retepora monilifera*, MacGillivray, form *munita*, Hincks.

*Retepora monilifera*, var. *munita*, Hincks, Ann. and Mag. Nat. Hist., ser. 5, vol. i. p. 361, pl. xix. fig. 5.

*Retepora monilifera*, form *munita*, MacGillivray, Trans. Roy. Soc. Vict., vol. xx. p. 108, pl. i. fig. 3; pl. ii. fig. 3; Zool. of Vict., dec. x. p. 22, pl. 96, figs. 4, 8.

*Retepora victoriensis*, Busk, Zool. Chall. Exp., part xxx. p. 117, pl. xxvii. fig. 7.

The specimen examined was from Station 162, 38 to 40 fathoms, but was evidently dead when dredged, and I have therefore not been able to make a detailed comparison.

*Retepora monilifera*, MacGillivray, form *umbonata*, MacGillivray.

*Retepora monilifera*, MacGillivray, form *umbonata*, MacGillivray, Zool. of Victoria, dec. x. p. 23, pl. 97, figs. 1-3.

*Retepora hirsuta*, Busk, Zool. Chall. Exp., part xxx. p. 119, pl. xxvi. fig. 4.

The Challenger specimen has the ovicell strongly umbonate, and the dorsal surface has vibices, usually with a line from a fenestra to each of those surrounding it.

*Retepora contortuplicata*, Busk.

*Retepora contortuplicata*, Busk, Zool. Chall. Exp., part xxx. p. 120, pl. xxvi. fig. 2.

On the dorsal surface small round avicularia are not common, but can be seen occasionally, and on the anterior surface, besides the triangular avicularia, there are small oval ones.

*Retepora columnifera*, Busk (Pl. III. figs. 10, 11).

*Retepora columnifera*, Busk, Zool. Chall. Exp., part xxx. p. 122, pl. xxvi. fig. 5.

This species receives its name from the "solid columnar dorsal processes" by means of which it is attached, but these calcareous attachment processes are by no means

uncommon in *Retepora*, and occur well marked in *Retepora imperati*, also in *Retepora lata*, *Retepora cellulosa*, &c., and probably depend upon the character of the ground where they have grown. In the specimen of *Retepora columnifera* which I have examined, there are chitinous tubes in the interior of these dorsal processes, looking at first as if they were produced by the *Retepora*, but they are the chitinous tubes of a *Caberea* or *Scrupocellaria*, and the *Retepora* has attached itself to the *Caberea*. By such means a *Retepora* might grow to considerable dimensions over ground that was unsuitable for direct attachment.

Surrounding the zoœcia at a slight distance from the surface, is a tube which is partly filled with a cellular cord. This<sup>1</sup> parenchymatous cord is common to the whole zoarium, but communicates with the zoœcia by means of threads near the oral aperture, and perhaps we shall find them elsewhere. This is seen in decalcified preparations; also in sections of the calcareous structure the hollow tube which contains it is very distinct near the anterior surface, but no indication is given on the surface of such a tubular structure; however, in *Retepora couchii* it can be seen in the "slightly raised tubular border" between the zoœcia, which I described in Ann. and Mag. Nat. Hist., ser. 5, vol. iii. p. 200. When describing *Retepora couchii* I decalcified specimens without finding the explanation, but perhaps I had unsuitable material, as I now can trace it. Although I have examined a considerable number of species without finding this common zoarial cord, yet I expect that it will be found in several *Reteporæ*. Jullien<sup>2</sup> says that *Retepora* and *Catenicella* are for him only words representing colonial forms and not generic forms, but both these genera shows important characters independent of the colonial form; with *Retepora* Hincks has pointed out several, and I have done the same with *Catenicella*, but for *Retepora* I would now point out another. The shell structure shows lines of deposition in a distinct way, which is peculiar to the genus, and besides the shell is not continuous but encloses hollow spaces or lacunæ. This is specially marked in *Retepora lata*, and is distinct in *Retepora cellulosa*; but in pointing out fresh characters, it must not be supposed that the present boundaries of a natural group may not have to be altered with extended knowledge.

*Retepora avicularis*, MacGillivray.

*Retepora avicularis*, MacGillivray, Trans. Roy. Soc. Vict., vol. xix. p. 288, pl. ii. fig. 6; Zool. of Vict., dec. x. p. 16, pl. 94, fig. 16; pl. 95, figs. 7-11.

*Retepora jacksoniensis*, Busk, Zool. Chall. Exp., part xxx. p. 125, pl. xxvii. fig. 4.

In the Challenger specimens the ovicell has not been noticed, but as the other characters correspond with *Retepora avicularis*, it would seem that it is identical with that species from Victoria.

*Habitat*.—Victoria; New South Wales. Fossil—Mount Gambier.

<sup>1</sup> The specimen examined was dry.

<sup>2</sup> Bryozoaires, Mission du Cap Horn, p. 5.

*Retepora magellensis*, Busk (Pl. III. fig. 5).

*Retepora magellensis*, Busk, Zool. Chall. Exp., part xxx. p. 126, pl. xxxvi. fig. 20.

There is on the zoëcium, about the middle, an avicularium with semicircular mandible, and on the dorsal surface there are also similar avicularia and divisional lines. These are distinctly seen when calcined, but otherwise may be overlooked, and no doubt this accounts for Mr. Busk's description "without vibices or dorsal avicularia." This corresponds in the zoëcial characters with *Retepora simplex* of the Challenger, but that name must be dropped, as Mr. Busk had already used it in his Crag Polyzoa. As *Retepora simplex* seems to be only a slender form, I should propose that it be distinguished as *Retepora magellensis*, var. *minima*. The variety *minima* has similar oral and surface avicularia, but the zoëcia are only about half as long as those of the variety *typica*.

*Turritigera stellata*, Busk (Pl. I. figs. 22, 25).

*Turritigera stellata*, Busk, Zool. Chall. Exp., part xxx. p. 130, pl. xxiv. fig. 1.

The end of the zoëcial tube is closed by a calcareous layer, reminding us of the closure of the *Cyclostomata*. In one case there is a prolongation of the zoëcium, formed by a plain narrow tube extending beyond the circle of avicularia, in another case sections show the calcareous closure to be double, but usually it is only single. When looking at the specimen in Edinburgh, I considered that the aperture was Schizoporellidan, but the piece brought away having no opercula, I have been unable to confirm the observation.

The inflation of some of the zoëcia, referred to by Mr. Busk, is an ovicell, as may be distinctly seen in sections.

*Cribrilina latimarginata*, Busk (Pl. I. figs. 11, 12).

*Cribrilina latimarginata*, Busk, Zool. Chall. Exp., part xxx. p. 131, pl. xxii. fig. 10.

A specimen from the Edinburgh duplicates has numerous large vibracula, and they are also well preserved in a specimen which I found at the British Museum among some duplicate material, and this is the only *Cribrilina* in which vicarious vibracula are known. When the vibracula are removed, a bar is seen extending half across the "large suborbicular opening." The vibraculum has a process at one side of the base, and this is situated below the bar, with one muscle attached to it and two powerful ones higher up. I have elsewhere alluded to the unsymmetrical shape of the base of the vibracula, and to this fundamental difference between avicularia and vibracula.

I do not find the flattened borders or bands as described by Busk, but, when calcined, a thick calcareous growth is seen surrounding the area, leaving small triangular hollows where the neighbouring zoëcia meet, or nearly meet, and a thick membrane covers the whole. The ovicell is not much raised, and has a triangular mark on the front. This is

materially different from *Celleporaria radiata*, Reuss, which I hope to refigure shortly from better specimens than were available for Professor Reuss.

Jullien<sup>1</sup> makes this the type of a new genus, *Jolietina*, but I cannot see that the grounds he gives at all justify the creation of another genus.

*Diporula hastigera*, Busk (Pl. III. figs. 28, 29).

*Flustramorpha hastigera*, Busk, Zool. Chall. Exp., part xxx. p. 136, pl. xxi. fig. 7.

This is very closely allied to *Diporula verrucosa*, Peach, of the Mediterranean and British seas, but instead of having the branches round they are compressed, and the operculum, though similar in shape, has the thick band round the border different. The avicularian mandible<sup>2</sup> corresponds in these two species; and I should see no reason to speak of this as vibraculoid, since it seems that the vibracula have the base of the seta unsymmetrical, with irregular projections for the attachment of muscles, thus allowing the vibracula motions in various planes. Believing in this fundamental difference between avicularia and vibracula, it does not seem that what Mr. Hincks<sup>3</sup> calls a vibraculoid appendage is anything more than a lengthened mandible, if we may judge from the figure of the lower zoecium (fig. 3).

The zoarium is ramose, with compressed dichotomous branches, rising from an expanded calcareous base, and has no chitinous tubes. It is not clear what Mr. Busk intended to include under *Flustramorpha*, since in the diagnosis of the genera he says, "lobes bordered, and loosely interconnected by chitinous tubes," which certainly does not apply to this species; but higher up on the same page he thinks it may be advisable to include in one group those "with or without the flexible stem and marginal bundles of tubes."

As this cannot come under the genus as defined by Busk, and as *Diporula* was based upon characters of importance, I have left it under *Diporula*, although believing that it will ultimately be merged in *Microporella*. This is very abundant in some washings of the dredge between Fayal and Pico, 50 to 90 fathoms.

*Microporella distoma*, Busk.

*Leprealia distoma*, Busk, Quart. Jour. Micr. Sci., vol. vi. p. 127, pl. xviii. fig. 1.

*Eschara distoma*, Busk, *op. cit.*, vol. vii. p. 66, pl. xxii. figs. 10-12.

*Adeonella distoma*, Busk, Zool. Chall. Exp., part xxx. p. 187, woodcuts, figs. 56, 57.

*Habitat*.—Madeira, 268 to 322 fathoms. Station 75, 450 fathoms. Washings of dredge between Fayal and Pico, 50 to 90 fathoms. Capri, 150 fathoms (A. W. W. coll.); Golfe de Gascogne (*vide* Jullien).

<sup>1</sup> Les Costulides, *Bull. Soc. Zool. de France*, tom. ix. p. 8.

<sup>2</sup> The opercula and mandibles of *Diporula verrucosa*, Peach, are figured in my papers on the use of the opercula and mandibles respectively.

<sup>3</sup> On the Polyzoan Avicularium, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ix. p. 23.

*Mucronella canalifera*, Busk (Pl. III. fig. 44).

*Mucronella canalifera*, Busk, Zool. Chall. Exp., part xxx. p. 159, pl. xxii. fig. 2.

There are several specimens from washings between Fayal and Pico.

The rule seems to be eight oral spines, and the lower edge of the aperture is nearly straight with two minute lateral denticles, giving the aperture the same character as that of *Cellepora albirostris*. I do not see any Mucronellidan character, and peristomial ones have never seemed to me satisfactory for generic divisions. There seems to be a relationship to *Lepralia*.

*Mucronella contorta*, Busk (Pl. I. fig. 24 ; Pl. III. fig. 30).

*Mucronella contorta*, Busk, Zool. Chall. Exp., part xxx. p. 155, pl. xx. fig. 9.

In the specimen from Simon's Bay there are small round avicularia replacing many of the pores. In a specimen from Algoa Bay, in my collection, these round avicularia are still more numerous, in some cases there being as many as seven to a single zoecium. There are three distal rosette plates, and there is a round calcareous process on each side of the aperture, projecting into the interior of the zoecium, for the support of the operculum. In my Algoa Bay specimen there are very few of the large avicularia by the side of the aperture, but there is usually a small one on each side nearer to the operculum. The operculum is very characteristic, having a thick band crossing it transversely. The "muero" of *Mucronella* occurs in very various ways, and I cannot see that the small projection, which we may call a lip in the present case, can be used as a generic character.

It seems that *Mucronella* may with advantage be dropped, and some, as the above, be placed with *Lepralia*, and the rest mostly show affinity with *Smittia*.

*Bracebridgia geometrica*, Reuss.

*Biflustra geometrica*, Reuss, Foram. Auth. und Bryozoen des deutschen Septarienthones, Denkschr. Akad. Wiss. Wien, Bd. xxv. p. 189, Taf. vi. fig. 16.

*Porella emendata*, Waters, Quart. Journ. Geol. Soc., vol. xxxvii. p. 336, pl. xvii. fig. 69.

*Mucronella pyriformis*, Busk, Zool. Chall. Exp., part xxx. p. 155, pl. xx. fig. 5.

*Bracebridgia pyriformis*, MacGillivray, Trans. Roy. Soc. Victoria, vol. xxii. p. 8 (sep.), pl. ii. figs. 6, 7; Zool. of Vict., dec. xvi. p. 219, pl. 158, figs. 6-8.

In the Challenger specimens the row of pores round the edge of the zoecium can be seen, entirely corresponding with those figured in the fossil, and in size the Australian fossil and recent are identical, though in the Challenger specimens I did not find any of the small diagonal avicularia. In one case, however, there was an appearance suggesting a broken down one. Also in the recent specimens from Victoria these avicularia are very

rare, so that in the first one examined I did not at once see any, but, recognising it as my *Porella emendata*, it was again examined with this object, and two or three only were found on a large colony, but thus the determination was confirmed.

It seems also related to *Eschara polymorpha*, Reuss, *loc. cit.*, p. 182, Taf. viii. fig. 8.

*Habitat*.—Victoria (MacGillivray); Port Phillip (Busk); and Station 162, 38 fathoms. Fossil—Curdies Creek (Australia); Sölligen (Oligocene).

*Smittia delicatula*, Busk (Pl. III. fig. 26).

*Mucronella delicatula*, Busk, Zool. Chall. Exp., part xxx. p. 156, pl. xviii. fig. 2.

This is a very typical *Smittia*, which might be called *Smittia trispinosa*, Johnston, var. *delicatula*. Mr. Busk speaks of the mucro being within the border of the orifice, but it is the denticle (lyrula) to which he refers; and in *Smittia* this lyrula seems always to be in front of the operculum, so that this is no exception, as Mr. Busk seems to suppose. This must have led him to place it under *Mucronella*. The ovicell is large, wide, raised, with a large area marked off, in which there are large perforations, the rest being granular.

*Smittia smittiana*, Busk.

*Smittia smittiana*, Busk, Zool. Chall. Exp., part xxx. p. 151, pl. xvii. fig. 3.

*Smittia stigmatophora*, Busk, *op. cit.*, p. 154, pl. xxii. fig. 6.

In the British Museum specimen of *Smittia smittiana*, named by Mr. Busk, I should call the ovicell decidedly depressed not “prominent;” in the specimen named *Smittia stigmatophora* the ovicells are also depressed, and usually have a small area in front with perforations; and it seems as if the marking with the few large pores, which Mr. Busk figured and called a stigma, only occurs in the young and undeveloped ovicells.

One of the specimens in Edinburgh, named by Mr. Busk *Smittia smittiana*, is adnate on *Vincularia*, and a specimen of typical *Smittia smittiana* which I found on *Ascidia meridionalis*, from Station 320, 600 fathoms, is also entirely adnate, showing that the “unattached” character is not constant in the same locality.

I wrote to Mr. Kirkpatrick to tell him that from my notes made in the British Museum I was convinced that *Smittia smittiana* and *Smittia stigmatophora* were synonyms, and he entirely confirmed my view, and said that the *Smittia smittiana* is of a larger build than *Smittia stigmatophora*, and he found stigma-like ovicells in *Smittia smittiana*, but this I only look upon as a stage of growth.

*Lepralia mucronata*, Smitt.*Escharipora mucronata*, Smitt, Floridan Bryozoa, p. 24, pl. v. figs. 113-115.*Mucronella mucronata*, Waters, Quart. Journ. Geol. Soc., vol. xxxvii. p. 328, pl. xvii. fig. 66; vol. xxxviii. pp. 266, 507; vol. xxxix. p. 436; vol. xli. p. 293; vol. xliii. p. 55.*Lepralia celleporoides*, Busk, Zool. Chall. Exp., part xxx. p. 142, pl. xvii. fig. 4.

In Smitt's species three pores are described, whereas there is only one in the Challenger specimens, but it is often trifoliate. I have pointed out that in the fossils there are sometimes three pores, sometimes five; and the avicularia is variable in size, being in some fossils very rare. The Challenger specimens have sometimes a slight mucro. The series should perhaps be divided into the varieties *unipora*, *tripora*, and *varipora*, but it seems that the recent and the fossils from the various Australian and New Zealand localities are all closely connected.

*Lepralia occlusa*, Busk (Pl. III. figs. 32-34).*Escharoides occlusa*, Busk, Zool. Chall. Exp., part xxx. p. 150, pl. xxi. fig. 8.

This is one of those cases where the shape of the aperture is partly Schizoporellidan, partly Lepralian. There is an avicularium at the side of the aperture, but I should hardly consider that this forms a sinal orifice, the character on which the genus *Escharoides* is based. The ovicell has an area on the front with large openings, the rest is imperforate. The specimen examined was from off Samboangan.

*Lepralia japonica*, Busk.*Lepralia japonica*, Busk, Zool. Chall. Exp., part xxx. p. 143, pl. xvii. fig. 5.

The ovicells are hardly at all raised above the surface of the zoecium, but are readily distinguished, as the ovicell is perforated with numerous small pores, whereas the surface of the zoecium has few large pores.

The structure of the ovicell shows that I was wrong in supposing that this was my *Monoporella crassatina*.

*Lepralia margaritifera*, Quoy and Gaimard (Pl. III. figs. 15, 16).*Flustra margaritifera*, Quoy and Gaimard, Voy. de l'Uranie, p. 606, pl. 92, figs. 7, 8.*Lepralia margaritifera*, Busk, Brit. Mus. Cat., p. 72, pl. ci. figs. 5, 6; Zool. Chall. Exp., part xxx. p. 145; Jullien, Bryozoaires, Mission du Cap Horn, p. 58, pl. ix. fig. 1.

This is the most interesting species that I have met with in the Challenger collection, on account of a very peculiar structure occurring in the avicularian chamber. As I only brought away a small fragment with the intention of comparing the "chitinous organs," the examination is not an exhaustive one.



In the suboral avicularian chamber, near to the mandibular end, there are two curious bodies partly embracing the muscular bands. The lower and wider one appears at first sight thin, as if it were a membranous wall separating the chamber, but sections leave no doubt in my mind of its being a sac, and the walls are formed of small nucleated cells. The smaller body rests upon this, and near the centre is tubular, spreading out at each end into a small gland-like body. In dissections or sections these two bodies usually adhere together and come away with the muscles.

Above there is a mass of "endorsac," which often assumes an annular form, and threads spread out in all directions, in some cases seeming to be attached to the larger of these sacs. The presence of this mass of endorsac is usual in the avicularia of the Chilostomata, but its taking an annular form seems to have been unnoticed.<sup>1</sup>

As to the function of the other two bodies the problem seems a puzzle, but I do not think that they must be considered alone, for in the zoœcia of many species there is at each side of the aperture a sac-like body, which in *Retepora cellulosa* (Pl. III. figs. 12, 13) attains a considerable size, and it also occurs in *Retepora tubulata*, *Retepora denticulata*, *Retepora jacksoniensis*, *Retepora producta*, *Rhynchopora bispinosa*, and I also found a similar, but much smaller, body in the zoœcia of *Lepralia margaritifera*, and they can be seen in *Cellepora coronopus*. Ostroumoff<sup>2</sup> figures sacs similar to those of *Retepora cellulosa* in *Lepralia pallasiana*, calling them glands, and Haddon figures two bodies in *Flustra carbasea*,<sup>3</sup> but no description is given; as Professor Haddon is on the other side of the world, no answer can be received to my question for some time. In this last case the bodies (*l.c.*) are not sac-like, but may nevertheless be homologous, as in *Cellepora pertusa* from the Red Sea there are in a similar position two narrow tubular vermiform bodies (Pl. III. fig. 14). Unfortunately, the spirit has evaporated from this specimen, which was bottled some years ago for further study.

Whether these bodies are in any way to be associated with the organs described by the late Dr. Joliet<sup>4</sup> as segmentary organs, is a question not unnaturally suggesting itself. The nature of these organs of Joliet is left by his paper and figures somewhat doubtful, but I do not follow him in his comparisons with the intertentacular organ of Farre, Hincks, and Smitt.

Jullien, who seems to have had good material available, only gives very large figures of the polypide without any detail, and these do not differ from the generality of Chilostomatous polypides. He does not, however, show either of the structures now described.

<sup>1</sup> It has always seemed to me that we must look for the explanation of the function of the avicularium to this mass of parenchym, or endorsac, for the avicularia remain in activity when the polypides have all disappeared, and in this way the tissues of the colony are indirectly in communication with the surrounding water, so that oxygenation takes place, and the colony is kept alive.

<sup>2</sup> Ostroumoff, *Archives Slaves de Biologie*, tom. i., pl. i. fig. 17. I can at the moment refer only to the plate in the Russian copy.

<sup>3</sup> Budding in Polyzoa, *Micr. Journ.*, vol. xxiii. p. 516, pl. xxxviii. fig. 12, *l.c.*

<sup>4</sup> Organe Segmentaire des Bryozoaires endoprocte, *Archives de Zool. expér.*, tom. viii. pp. 497-512, pl. xxxix.

No doubt, now that our attention is called to these bodies, we shall find them in many other cases, though I have looked through many preparations showing the organic structure without detecting them.

*Porella proboscidea*, Hincks, seems closely related, but differs in having the oral avicularium prolonged in a tubular manner.

*Lepralia lonchæa*, Busk.

*Lepralia lonchæa*, Busk, Zool. Chall. Exp., part xxx. p. 146, woodcut, fig. 43.

The specimen in the British Museum has ovicells, which are large, somewhat decumbent, and the lower border of the peristome encloses a sort of shelf. Avicularia placed diagonally on the side of the peristome. The general character and the ovicell would indicate that it is the same as *Lepralia vestita* of Hincks, from Tahiti; but there seems to be a difference in the operculum, which prevents my uniting them without a more complete examination.

*Lepralia castanea*, Busk (Pl. III. figs. 36, 37).

*Mucronella castanea*, Busk, Zool. Chall. Exp., part xxx. p. 157; pl. xix. fig. 6.

In most specimens the projection of the lower border of the oral aperture is not as distinct as shown in Mr. Busk's figure. A lip of this kind occurs in several cases in *Lepralia*, and the operculum indicates that it should be placed with *Lepralia*. *Mucronella* is a genus which in my opinion should be abolished, and species have been placed under it with a distinct mucro, with an avicularian chamber, with a lip, or with an internal denticle, as *Smittia delicatula*. Some seem to belong to *Lepralia*, most to *Smittia*, but even if the genus *Mucronella* be retained this could not be placed there. Specimens from Station 122, 350 fathoms, have one or more large dorsal pores, from which proceed radical tubes. The dorsal structure is just the same as that of *Lepraliu dorsipora*, as radical tubes in that case also proceed from the "large oval or reniform openings."

This may be related to *Lepralia vicina*, Reuss, Foss. Bry. Cest-Ung. Mioc., Taf. vii. fig. 10.

*Aspidostoma gigantea*, Busk (Pl. I. figs. 16-18; Pl. III. figs. 20, 21).

*Aspidostoma giganteum*, Busk, Zool. Chall. Exp., part xxx. p. 161, pl. xxxiii. fig. 3, and synonyms; Jullien, Bryozoaires, Mission du Cap Horn, p. 77, pl. vi.

*Micropora cavata*, Waters, Quart. Journ. Geol. Soc., vol. xxxix. p. 435.

In the Challenger specimens the "penthouse-like projection" is quite distinct on the two sides, and in many cases each divides and forms a solid cervicorne process.

The avicularia in the Challenger specimens are numerous, and occur as described by Hincks; there are a few ovicells, which cannot be called elongate, but short, depressed. The ovicells open so far away from the oral aperture that it seems very problematical how the ova enter into the ovicell. The operculum has a prolongation at each lower corner, fitting into the clefts below the oral aperture. These subopercular appendages expand at the end, and become thicker both above and below, furnishing strong supports for articular attachment.

The form of the aperture is much the same as that described by Koschinsky in his genus *Rhagasostoma*.<sup>1</sup>

*Habitat*.—Patagonia; Falkland Islands. Fossil—Victoria (Australia).

*Hippothoa divaricata*, Lamouroux.

*Hippothoa divaricata*, Hincks, Brit. Mar. Polyzoa, p. 288, pl. xlv. figs. 1–4; pl. i. fig. 2 which see for synonyms.

*Hippothoa divaricata*, Busk, Zool. Chall. Exp., part xxx. p. 4.

Specimens from washings from dredge between Fayal and Pico, 50 to 90 fathoms, are sometimes in linear series, sometimes crowded, without showing any caudal prolongation; surface granular, with the lower lip much raised, often forming an umbo, sometimes with a peristome all round the aperture. The umbonate ovicell is not as wide as the zoæcium.

This seems to most nearly correspond with var. *abstersa*, Busk, from the Crag.

*Schizoporella tenuis*, Busk.

*Schizoporella tenuis*, Busk, Zool. Chall. Exp., part xxx. p. 165, pl. xx. fig. 10.

In the British Museum specimen from Simon's Bay there are large globose ovicells, just the same as in *Schizoporella nivea*, and, unless there has been some mistake in labelling, I am convinced that these two forms should be united under one name.

*Schizoporella polymorpha*, Busk (Pl. II. figs. 21–24).

*Gephyrophora polymorpha*, Busk, Zool. Chall. Exp., part xxx. p. 167, pl. xxxiv. fig. 2.

This does not seem to be the *Schizoporella biturrita*, Hincks (*Schizoporella tuberosa*, Reuss), as both Mr. Hincks and I thought from the description. In the Challenger specimens there is a concealed globular ovicell only attached at the ovicellular opening, and situated above the operculum. The wall of this ovicell is thin, but calcareous, and its form can be very well seen in prepared sections. Mr. Busk evidently refers to this when speaking of two compartments into which he divides the cavity of the zoæcium.

<sup>1</sup> Bryozoenfauna der aelt. Tertiär des sud Bayerns, p. 29, *Palæontographica*, vol. xxxii.

but it would seem that he must have examined some broken down specimens. I propose to call this a concealed ovicell, retaining the expression immersed for those which give an external indication of their presence.

The bridge between the two lateral avicularia rises up into a kind of mucro, turning, however, at right angles to the axis of the zoarium, and projecting but little over the aperture. In the specimen examined there is a semitransparent membrane covering the whole surface.

*Schizoporella challengerii*, n. n. (Pl. II. figs. 25–28).

*Myrionozoum immersum*, Busk, Zool. Chall. Exp., part xxx. p. 170, pl. xxv. fig. 4.

A specimen from Station 320, 600 fathoms, shows that Mr. Busk never saw the oral aperture, and in fact it never can be seen except on a broken surface or in section, since it is placed nearly at right angles to the axis of the zoarium, instead of being parallel as usual. What Mr. Busk took for the oral aperture and figured (4 c) is only the lower part of the secondary orifice, and the tube leading to the avicularium projects into this immersed peristome, causing the appearance which misled Mr. Busk. This I show in section in fig. 27. Another point of very great interest is the discovery of a concealed ovicell opening into the peristomial tube (see fig. 25). Only a small fragment, however, was available for making a section, and this point should be further studied in young growing branches, but I think my interpretation will be found correct. It should, however, be noticed that the cavity is below the peristome, and not above. As *Onchopora immersa*, Haswell, would seem to be *Schizoporella*, it is requisite to change the name.

*Schizoporella vitrea*, MacGillivray (Pl. III. figs. 31, 46).

*Lepralia vitrea*, MacGillivray, Zool. of Viet., dec. iv. p. 32, pl. 38, fig. 4.

*Lepralia incisa*, Busk, Zool. Chall. Exp., part xxx. p. 145, woodcut, fig. 42.

There is already *Lepralia incisa*, Reuss, but the Challenger form is no doubt the *Schizoporella vitrea* of MacGillivray. In some parts of the colony the zoecia are oblong with straight sides, in others the zoecia may be called oval. In well-preserved parts the surface appears covered with white spots, and in the centre of each is the pore. The avicularia are acute, and not "oval." The ovicell is round, raised, but partly immersed in the zoecium above, and with a granular surface.

*Habitat*.—Station 135A, off Inaccessible Island, 75 fathoms; Williamstown (Victoria).

*Myrionozoum marionense*, Busk.

*Myrionozoum marionense*, Busk, Zool. Chall. Exp., part xxx. p. 171, pl. xxiii. fig. 6.

Through Miss Busk's kindness, I have been able to examine specimens from three localities, and see that they are in no way similar to my *Porina* (?) *inversa*, as I at one

time thought. In all the specimens that I have seen the avicularia are well within the peristome, and I have not seen one in which they are erect as in Mr. Busk's figure (6 c).

*Myrionozoum truncatum* has the connection from cell to cell through numerous tubes like the pore tubes on the outside of the zoarium. This would seem to be a characteristic of *Myrionozoum*, and differs so much from the usual growth of Chilostomata, that I have often thought a suborder should be made for it on this account, but finding the same structure in *Porina coronata* (*Haswellia australiense* in Challenger Report) militates against that view.

*Haswellia* (?) *auriculata*, Busk (Pl. III. fig. 38).

*Haswellia auriculata*, Busk, Zool. Chall. Exp., part xxx. p. 173, pl. xxiv. fig. 10.

*Porina grandipora*, Waters, Quart. Journ. Geol. Soc., vol. xliii. p. 59, pl. vii. fig. 23.

In a specimen from Station 135A, 75 fathoms, the central portion of the operculum is granulated, and the muscular attachments are lower down and nearer to the centre than in *Porina coronata*. Near the base at each side there is a round thin spot, no doubt fitting on to a denticle, as explained for the opercular "foramina" of *Cellaria*. The ovicells are immersed with a thin circular area in front, but I have not seen the raised narrow fillet as figured by Mr. Busk, and in the older cells the ovicells would be overlooked if not previously noticed in the younger. I am unable to find any trace of a suboral pore, but no doubt a bridge sometimes forms a "pore." This would seem to be *Schizoporella*, but as there is already *Schizoporella auriculata*, the name will have to be changed. As, however, the operculum with the thin spot varies somewhat from most *Schizoporella*, I have provisionally retained Busk's generic name.

Since the above was written, the comparison of some specimens from New Zealand, which Miss Jelly gave me as recent *Porina* (?) *grandipora*, shows that although somewhat smaller, and the bridge much more developed than in the Challenger specimens, they are undoubtedly identical. The operculum of the New Zealand specimens, though slightly smaller, has the characters quite similar.

From washings of the dredge between Fayal and Pico there are numerous fragments of an erect cylindrical form, about 1 mm. in diameter, with few zoecia irregularly placed. The surface is smooth and the peristome projects at each side, carrying a raised triangular avicularium. In a slender specimen a bridge is formed over the aperture, and then the zoecial appearance is just the same as in the specimens from New Zealand. In the operculum there is a difference, as the muscular attachments are placed very high, with two dots lower down, and the proximal border forms a very obtuse angle. This form, which may be called var. *fayalensis*, also occurs off Capri.

*Habitat*.—Add, New Zealand. Fossil—Napier (New Zealand).

*Porina coronata*, Reuss, var. *labrosa*, Reuss.

*Cellaria labrosa*, Reuss, Foss. Polyp. Wien Tert., p. 63, pl. vii. fig. 35.

*Haswellia australiensis*, Busk, Zool. Chall. Exp., part xxx. p. 172, pl. xxiv. fig. 9.

In a specimen sent to me by Mr. Haswell, from Holborn Island, the entire peristome projects, whereas in the Challenger specimen it is only the proximal lip which projects. The same is the case in fossil *Cellaria labrosa* which I collected from the Val di Lonte, in the Vicentine, and from Brendola, in the Colle Berici, Northern Italy, both of Bartonian age. I hope shortly to refer more fully to these in a revision of the Italian Miocene Bryozoa, upon which I am now at work. Finding the same varieties and variations of mode of growth in the Australian seas and in the Miocene beds has largely influenced me in uniting as synonyms *Porina gracilis*, *Porina coronata*, and *Myriozoum australiense*, and has even influenced my views as to the range of other species. The opercula of the Challenger specimen have the muscular attachments in the same position as those both from Holborn Island and typical *Porina gracilis*, in all cases being about the same size.

The ovicells have not been described, but in my Holborn Island specimen the zoarium at some whorls becomes thicker, and when sections are made the ovicell is found above the peristome (Pl. II. fig. 8). These must be considered immersed ovicells, as some indication of their position is given externally. This is the same position and form as in typical *Porina gracilis*.

A further character common to both is the tubular connection from zoecium to zoecium. These tubes are uniform, and resemble those leading to the exterior, and in consequence there are no definite rosette plates such as we find in most Chilostomata. This is much the same structure as in *Myriozoum truncatum*, and I have elsewhere expressed the belief that this may possibly turn out to be an important classificatory character.

It will thus be seen that typical *Porina coronata* and *Porina gracilis* have three most important characters similar and very marked.

*Adeonella polymorpha*, Busk (Pl. II. figs. 9–11, 40).

*Adeonella polymorpha*, Busk, Zool. Chall. Exp., part xxx. p. 183, pl. xxi. figs. 1a, 2a, 3, 3a (not figs. 1, 2).

The young cells are elongate, with pores on the surface, often appearing as if in four rows; the arch is then formed with, in most cases, a small avicularium at each side of the bridge. In the oöcial cells the peristomial pore is frequently divided by a bar in front, but this is not often the case in the other cells. In this and several other particulars *Adeonella polymorpha* and *Adeonella intricaria* are similar. The older cells mostly have an elongate avicularium on a more or less raised mound.

The bridge is formed in front of the operculum, starting from each side, with the arches meeting in the middle, thus forming the pore in the peristome. The bridge and pore are formed in this same way in the group, which I maintain should be alone considered as *Adeonella*, and includes *Adeonella polymorpha*, *Adeonella platatea*, *Adeonella intricaria*, *Adeonella atlantica*, *Adeonella pectinata*, *Adeonella polystomella*—all of which I have now seen. In these cases the bridge is formed irrespective of the avicularia, whereas in *Gephyrophora polymorpha* the arch carries the large lateral avicularia. In *Adeonella polystomella*, Reuss, the arch is not as solid, and the oral sinus can be seen below, but the real structure of the bridge is similar.

None of this group have the lower margin of the oral aperture straight. This I have alluded to before, but Mr. Hincks (*op. cit.*, p. 152) says that *Adeonella intricaria* and *Adeonella pectinata* are described as having the lower margin of the orifice straight; this, however, only refers to the peristomial orifice. It should be noticed that the figures of the opercula of *Adeonella intricaria* are given upside down in the Challenger Report, as may be seen from the scale and the mandibles, but when looked at the right way they show that the lower margin is round. *Adeonella polystomella* and *Adeonella regularis* have a distinct oral sinus, but in the other cases the edge is a wide curve.

It should not be overlooked that the zoœcia of this group are all very small, and are about the same size in all the species.

*Adeonella intricaria*, Busk (Pl. II. fig. 39).

*Adeonella intricaria*, Busk, Zool. Chall. Exp., part xxx. p. 185, woodcuts, figs. 51–53, pl. xxi. fig. 2.

In the specimen sent to me from Station 190, the young cells have pores spread generally over the surface in the same way as in *Adeonella atlantica*, but they are not quite so numerous, and are larger. The small avicularium on the one side of the bridge is very seldom found on the ordinary cells, but usually occurs on the larger or œcial cells. It is also in these larger cells that the sublabial pore becomes divided by a bar across the pore. As I have already pointed out, the opercula are figured by Busk upside down. The woodcut shows that it has been in part reversed.

In the mature, but not overgrown, cells the oral aperture can often be seen under the bridge in the same way as in *Adeonella polystomella*.

*Adeonella atlantica*, Busk (Pl. II. figs. 20, 37).

*Adeonella atlantica*, Busk, Zool. Chall. Exp., part xxx. p. 186, pl. xx. fig. 7; pl. xxi. fig. 1*b*.

The pore is placed so low down, that from an external examination it would be supposed that it opened into the zoœcial cavity, and several preparations were made

before this point was cleared up ; but the one figured shows quite distinctly that the pore opens into the peristomial tube immediately above the operculum. The younger cells are without pore or avicularium, but the older ones are usually provided with two avicularia. The young cells of this, of *Adeonella intricaria*, and of *Adeonella polymorpha* are very similar as regards the surface pores.

When the zoarium is examined from the side, the zoœcia of the back and front series are seen to be opposite.

Specimen examined from Station 135c, 110 fathoms.

*Adeonella* (?) *regularis*, Busk (Pl. II. fig. 35).

*Adeonella regularis*, Busk, Zool. Chall. Exp., part xxx. p. 186, woodcut, fig. 55, pl. xx. fig. 2.

This differs from the other *Adeonellæ* in having very large zoœcia, and the bridge across the aperture is much more slender—in fact, it should now be called a bar. Besides the avicularia described as “above the mouth,” there is very frequently one at the base of the bar, directed towards the aperture. A bar across the aperture occurs in the fossil (*Escharipora*) *ornatissima*, Stoliczka,<sup>1</sup> and also in (*Eschara*) *syringopora*, Reuss. (This bar was not described by Reuss, but I have it in well-preserved specimens from the Miocene of Italy.)

The oral aperture has a narrow sinus, and the tongue of the operculum is very marked, not being quite in the same plane as the disk of the operculum, but is not separated as in *Schizoporella cecilii*, Audouin. I have not found any mandibles with the trident-shaped basis figured by Busk.

The general appearance reminds us of *Gephyrophora polymorpha*, and it is by no means easy to know where it should be placed, and my judgment would be to call it *Schizoporella*.

*Cellepora pustulata*, Busk (Pl. III. fig. 1).

*Cellepora pustulata*, Busk, Zool. Chall. Exp., part xxx. p. 200, pl. xxviii. fig. 8.

The ovicell is small and recumbent, and on the front, near the opening, has a thin semicircular area. A similar small semicircular mark occurs on the ovicells of many *Celleporæ*, among others, on *Cellepora ansata*, Busk ; *Cellepora eatonensis*, Busk ; *Cellepora bicornis*, Busk. The operculum does not close the ovicell, and shows that the oral aperture is emarginate, and not clithriate.

<sup>1</sup> Olig Bry. von Latdorf, *Sitzungsb. d. k. preuss. Akad. d. Wiss.*, Bd. xlv. p. 86, Taf. ii. fig. 7.



*Cellepora megasoma*, MacGillivray.

? *Lepralia megasoma*, MacGillivray, Zool. of Vict., dec. iv. p. 33, pl. 38, fig. 5.

*Cellepora megasoma*, MacGillivray, Trans. Roy. Soc. Vict., vol. xxi. p. 115, pl. iii. fig. 5; Zool. of Vict., dec. xv. p. 183, pl. 148, fig. 1.

*Cellepora cylindriformis*, Busk, Zool. Chall. Exp., part xxx. p. 201, pl. xxx. fig. 9; pl. xxxvi. fig. 9.

An unnamed specimen from Station 142, which I brought from Edinburgh, is the *Cellepora cylindriformis* of Busk, and at first incrusts a piece of seaweed, and then grows free in a cylindrical form.

*Habitat*.—Station 142, 150 fathoms; and Port Phillip Heads (MacGillivray).

*Cellepora pumicosa*, Busk (*non* L.), var. *eatonensis*, Busk.

*Cellepora eatonensis*, Busk, Zool. Chall. Exp., part xxx. p. 201, pl. xxix. figs. 4, 6, 8; pl. xxxvi. figs. 3, 4, 5.

This differs but slightly from the European *Cellepora pumicosa*; the avicularium is round instead of triangular. The ovicell is globular, in older cells immersed, and has the small semicircular mark already alluded to.

Named specimens from Station 315, 12 fathoms, and unnamed ones from Station 149, 20 fathoms, examined.

*Cellepora bicornis*, Busk.

*Cellepora bicornis*, Busk, Zool. Chall. Exp., part xxx. p. 202, pl. xxx. figs. 1, 12; pl. xxxvi. figs. 13, 15.

This I found on *Cellaria* from Station 151, 75 fathoms. Both in this and in specimens from Marion Island, in the Challenger Office, the ovicell has a small semicircular flattened area. It is probable that some of the other Challenger *Celleporæ* will be found to be identical with this, and perhaps that it has already been described by MacGillivray.

*Cellepora conica*, Busk.

*Cellepora conica*, Busk, Zool. Chall. Exp., part xxx. p. 203, pl. xxviii. fig. 10; pl. xxxvi. figs. 1, 2.

Upon making preparations of the chitinous elements of a small cylindrical piece brought from Edinburgh, which Mr. Busk had named *Cellepora simonensis*, the correspondence with the very characteristic elements of *Cellepora conica* was apparent, and it was clear that *Cellepora conica* may also grow as a solid cylindrical branching form. This shows how artificial are the divisions instituted by Mr. Busk, based on the form of the zoarium, and misled even Mr. Busk himself. The orifice is somewhat

depressed, with usually a small raised avicularium at each side, and sometimes another one above the aperture. There are numerous vicarious spatulate avicularia, and the numerous globose ovicells are punctured; in the young cells they are much raised, but in the older ones immersed. Mr. Busk thinks that this may be the *Cellepora avicularis* of Smitt, but the shape of the oral aperture is quite different, as may be seen in Smitt's Floridan Bryozoa, pl. ix. fig. 197, and in my Bryozoa of Naples, pl. xiv. fig. 8.

*Habitat*.—Simon's Bay, Cape of Good Hope.

*Cellepora armata*, Hincks, var. *erecta*, nov. (Pl. III. figs. 4, 41–43).

The zoöcial characters are the same as in the European forms, which, however, are adnate, whereas the Challenger one is cylindrical. There is a distinct sinus in the aperture, and by the side are situated long tubular processes, with a triangular avicularium at the end.

*Cellepora hastigera* has similar long rostral avicularia, but the shape of the aperture is of a different type.

*Habitat*.—Station 308, 175 fathoms.

In *Cellepora honolulensis*, Busk,<sup>1</sup> and *Cellepora mamillata*, var. *atlantica*, Busk,<sup>2</sup> the ovicell is only an open hood. *Cellepora bilabiata*, Busk,<sup>3</sup> has radiating pores round the border of the area of the ovicell.

*Palmicellaria skenei*, Ellis and Solander.

*Millipora skenei*, Ellis and Solander, Zoophytes, p. 135.

*Palmicellaria skenei*, Hincks, Brit. Mar. Poly., p. 379, pl. lii. figs. 1–4, which see for synonyms, and add *Cellepora tridens*, Kirchenpauer, Untersuchungs-Fahrt. der Pommerania, p. 188, figs. *a* and *b*.

The specimen from Station 49 may be considered as the var. *tridens* of Kirchenpauer. The name was used independently by Mr. Busk. There are three avicularia rising above the aperture, and sometimes a fourth. The mandibles are similar to the typical *Palmicellaria skenei*, but are much smaller.

*Habitat*.—Station 49, 85 fathoms.

*Cupularia canariensis*, Busk (Pl. III. fig. 2).

*Cupularia canariensis*, Busk, Quart. Journ. Micr. Soc., vol. vii. p. 66, pl. xxiii. figs. 6–9.

For synonyms see Waters, Bryozoa from New South Wales, Ann. and Mag. Nat. Hist., ser. 5, vol. xx. p. 201.

An unnamed specimen from off Bahia, 10 to 80 fathoms, has the zoarium orbicular,

<sup>1</sup> Zool. Chall. Exp., part xxx. p. 195.

<sup>2</sup> loc. cit., p. 199.

<sup>3</sup> loc. cit., p. 203.

depressed, about 6 mm. in diameter. Area oval, with the sides sloping steeply down, but not forming a lamina. The membranous portion of the front wall projects, with the opercular aperture at the end; and the opercular opening exhibits very different shapes, according to the position, but usually like fig. 2, though I have found some like the aperture of *Cupularia monotrema*, as figured by Mr. Busk.<sup>1</sup> The vibracular opening has on one side a distinct auricular projection. Dorsal surface with concentric sulci with cross divisions, and usually one large pore in the centre of the area thus formed, but in parts of the zoarium there are several pores in one of these areas. The membrane covering the dorsal surface does not show any trace of these pores. This is a somewhat surprising fact, as in the Chilostomata generally the position of the pore tubes is distinctly shown on the covering membrane.

The resemblance to *Cupularia monotrema*, as described by Busk from the same locality, is evident, but *Cupularia canariensis* has no avicularia. The examination of *Cupularia monotrema* does not seem to have been sufficient for us to be quite sure as to its position. I therefore wrote to Mr. Kirkpatrick, after examination of the specimen brought from Edinburgh, telling him what I had noticed; and in reply he says—"Calcination of a fragment of *Cupularia monotrema* reveals its specific identity with *Cupularia canariensis*. The avicularian cells (the only point of difference between the two species) have orifices similarly shaped to those of the vibracula, and the mandibles are vibraculoid. In shape of zoecium, of lamina, dorsal surface, and in character of operculum, the two species resemble each other."

Mr. Busk says that the distinction between *Cupularia canariensis* and *Cupularia guineensis* is sufficiently obvious; but I must confess to not understanding upon what characters they are separated, and still adhere to the opinion elsewhere expressed, that they are synonymous.

*Habitat*.—Off Bahia, 10 to 80 fathoms; Canaries; Madeira; Florida; New Guinea; Torres Strait; Philippine Islands, North-East Australia; Coast of Liberia 38 metres (specimen sent by Jullien). Fossil—Miocene and Pliocene of Europe; Aldinga, South Australia.

*Selenaria maculata*, Busk (Pl. III. fig. 3).

*Selenaria maculata*, Busk, Cat. Mar. Polyzoa, p. 101, pl. cxvii.; Waters, Quart. Journ. Geol. Soc., vol. xxxix. p. 440, pl. xii. figs. 7, 9, 12; *ib.*, vol. xli. p. 309; Ann. and Mag. Nat. Hist., ser. 5, vol. xx. p. 201; Haswell, Polyzoa from the Queensland Coast, p. 42.

I found three unnamed species from off Port Jackson, 30 to 35 fathoms. In the central cells the lower half of the oral aperture is closed by a calcareous cover.

The membrane covering the front of the zoecium has "trabeculæ" surrounding the

<sup>1</sup> Zool. Chall. Exp., part xxx., pl. xiv. fig. 5.

operculum, and in this character resembles *Cellaria*. The vibraculum has an articular caput, and has various projections for the attachment of muscles, but the shape will best be understood from the figure.

The dorsal surface shows the pores stellate, or, perhaps more correctly, there are tubercles round the pores, giving a stellate appearance.

*Habitat*.—Port Jackson, 30 to 35 fathoms; Holborn Island and Barnard Island, Australia. Fossil—Victoria and South Australia.

*Farciminaria biseriata*, n. sp. (Pl. I. figs. 2, 3).

This I found from Station 122 growing on *Bifaxaria corrugata*, and afterwards another small specimen growing on *Kinetoskias*. The zoarium is erect, attached by horny tubes, and in the larger specimen the zoœcia are distinctly in pairs and opposite, whereas in the smaller one they must be called alternate, with the zoœcia facing in two directions; the sides of the zoœcia are much raised above the flat central part, which is in the same plane as the operculum. The surface is distinctly granulated, with the granulations very marked at the edges. The oral aperture is rounded above and straight below, with a calcareous bar at the base, formed by a thickening of the wall, and on this bar there are two minute knobs or denticles.

The horny tubes usually arise from the front of the zoœcium, but the position is not constant.

It is difficult to see where this should be placed, and the description of *Farciminaria* would require enlarging to receive it, as there is more calcareous matter in it than is usual, and the arrangement of the zoœcia is different; but these are not characters of sufficient importance to justify a new genus, and I therefore place it provisionally with *Farciminaria*.

*Habitat*.—Station 122, lat. 9° 5' S., long. 34° 50' W.; 350 fathoms. Red mud.

*Flustra separata*, n. sp. (Pl. I. fig. 9).

The zoarium appears to be broadly lobate, and the two layers are only attached at the border of the zoarium, so that if the outside zoœcia are cut through the whole separates like two sheets of paper.

The zoœcia are oval without any spines, and they are sometimes replaced by large vicarious avicularia, closed by large spatulate mandibles, having two strong chitinous ridges starting from near the distal end, and curving out to the proximal corners.

There are on the distal wall 5 to 6 small rosette plates.

In some cells a small digitiform process hangs down inside from near the aperture, and expands at the end in three or four globular projections. This is seen to be the

remains of a former polypide, and the position so high up is peculiar. There are no ovicells in the specimen examined.

*Habitat*.—Station 49, lat. 43° 3' N., long. 63° 39' W.; 85 fathoms. Gravel, stones.

*Porina proboscidea*, n. sp. (Pl. I. figs. 19, 20).

The zoarium is formed of cylindrical branches nearly in one plane, and bifurcating at a small angle, with zoœcia only opening on the one side of the zoarium. The zoœcia are often much prolonged, and widen out at the extremity, and frequently there are on this projecting zoœcial tube either ridges or spinous processes. Below the middle of the zoœcium there is a suboral pore with a tubular projection.

There are small round or nearly round avicularia, both on the anterior and posterior surfaces, and these are usually on the same transverse line as the suboral pore. There are also non-avicularian pits. The ovicell usually occurs near a bifurcation, almost entirely immersed with large pores on the surface.

The appearance of the zoarium reminds us of *Filisparsa*, whereas the zoœcial characters are very similar to those of *Porina coronata*, and I believe this is the first time that *Porina* has been met with having the zoœcia only on the one face.

The projecting zoœcia reminding us of *Entalophora proboscidea*, suggested the same specific name which appropriately describes the projecting zoœcia.

*Habitat*.—Station 23, off St. Thomas, 450 fathoms. Pteropod ooze.

I do not know where to place a small specimen from Station 320 (Pl. III. fig. 47). The zoarium is slender, cylindrical, branched, attached by means of a bundle of radical fibres. Zoœcia completely immersed, and the aperture also immersed, with a small triangular avicularium at the proximal edge. Surface with elongate pores. This in growth and general character is the same as *Bifaxaria abyssicola*, but has no large avicularia, and the zoœcia are on all sides of the zoarium, though more abundant on what we may in consequence call the front.

In *Lepralia bisinuata*, Smitt, the double sinus is only peristomial, and the lower edge of the operculum is straight.

In *Schizoporella jacksoniensis*, Busk, the ovicells are immersed, and the ovicelliferous zoœcia have the oral aperture wider than the other zoœcia.

*Microporella coscinopora*, var. *armata*, Waters, occurs from Station 162, off Monœour Island, Bass Strait, 38 to 40 fathoms, also *Schizoporella woosteri*, MacGillivray, and *Mucronella tricuspis*, Hincks.

*Chorizopora brongniartii*, Audouin,<sup>1</sup> also occurs from washings of dredge between Fayal and Pico, 50 to 90 fathoms, as well as *Mastigophora hyndmanni*, Johnston, and

<sup>1</sup> Zool. Chall. Exp., part xxx. p. 148.

*Micropora coreacea*, Esper, *Lepralia pertusa*, Esper, *Schizoporella auriculata*, Hassall, *Cellepora costazii*, Audouin, *Entalophora clavata*, Busk.

*Escharoides verruculata*, Busk.<sup>1</sup> I do not think this is the *Chorizopora verruculata* of Smitt, but believe that it is the *Rhynchopora profunda*, MacGillivray, but there was not material for further study. It has a large internal denticle placed diagonally.

*Cribrilina monoceros*, Busk, add Station 320, 600 fathoms.

*Fron dipora verrucosa*, Lamouroux.

*Madrepore rameux*, &c., Marsigli, Hist. Phys. de la Mer., p. 150, pl. xxxiv. figs. 165, 166.

*Krustensteria verrucosa*, Lamouroux, Expos. Méth., p. 41, pl. lxxiv. figs. 10–13 (juv.), pl. xxvi. fig. 5.

*Fron dipora reticulata*, Blainv., Man. d'Actin., p. 406, pl. lxxix. fig. 1; Smitt, Öfersigt. k. Vetensk. Akad. Förhandl., vol. xxiii. 1866, p. 407, var.  $\alpha$  and  $\beta$ ; Busk, Mar. Polyz., part iii. p. 38, pl. xxi.; A. Milne-Edwards, Arch. des Missions Scient. et Litt., ser. 3<sup>me</sup>, vol. ix. p. 22.

*Fron dipora verrucosa*, Busk, loc. cit., p. 39; Waters, Ann. and Mag. Nat. Hist., ser. 5, vol. iii. p. 279, pl. xxiv. figs. 1–7.

*Fron dipora marsillii*, Mich., Icon. Zooph., p. 68, pl. xiv. fig. 4; Pergens, Plioc. Bry. von Rhodes. Ann. Nat. Hist. Hofmuseums, vol. ii. p. 11, pl. i. fig. 3, 4.

Specimens in Edinburgh from Station 135c, marked *Fasciculipora ramosa*, are most undoubtedly *Fron dipora*, spreading out for some inches with nearly round branches, frequently dichotomising, and often anastomosing, but also sometimes throwing out thin connecting bars from neighbouring branches.

From the specimens examined in the Mediterranean, I still adhere to my opinion that *Fron dipora reticulata* and *Fron dipora verrucosa* are undoubtedly the same, but as pointed out and shown in my figures (loc. cit., figs. 4–6), the young colonies are in some stages much like the *Fasciculipora ramosa* of Busk. Although from Nightingale Island and marked *Fron dipora ramosa*, I should presume these specimens have not been critically examined, and that the description has slipped in from some others.

*Habitat*.—Station 135c, off Nightingale Island, 110 fathoms; Mediterranean. Fossil—Pliocene of Sicily (A. W. coll.); Rhodes (P.).

*Idmonea bifrons*, Waters.

*Idmonea bifrons*, Waters, Quart. Journ. Geol. Soc., vol. xl. p. 685, pl. xxx. figs. 10, 11.

The zoarium is nearly cylindrical, but slightly compressed laterally, about 1.5 mm. in diameter, with 6 to 10 zoecia on each side of an anterior and dorsal median line;

<sup>1</sup> Zool. Chall. Exp., part xxx. p. 150.

sometimes the row of zoœcia is continuous, but often more or less interrupted at the side, in which case it has the appearance of two *Idmoneæ* joined back to back. This has been found fossil, and sometimes called *Idmonea disticha*, but as "*Retepora disticha*" of Goldfuss apparently relates to two or three species, and as there has been much confusion in the use of the specific term *disticha*, I found it necessary to rechristen it; and although Dr. Pergens has since called it *Idmonea disticha*, the reasons already given seem to justify the new name.

*Habitat*.—Washings of dredge between Fayal and Pico, 50 to 90 fathoms; abundant.

*Defrancia striatula*, Busk (Pl. III. fig. 45).

*Defrancia striatula*, Busk, Crag Polyzoa, p. 117, pl. xvii. fig. 5.

Zoarium stipitate. Zoœcia in much elevated, bi-multiserial rays starting from near the centre and extending to the margin of the cup. Central portion and interspaces without cancelli; opening of the ovicell infundibuliform between two of the rays, but the inflation is so very slight, that it would pass unnoticed except for the opening. Dorsal surface divided into subhexagonal divisions, the peduncle longitudinally ridged.

In appearance this resembles *Defrancia lucernaria*, Sars, but differs in not having the central portion cancellate. It is also much like *Tubulipora brongniartii*, M. Ed. and Manzoni, and also like *Pelagia insignis*, Mich., but we are yet much in the dark concerning the classification of such forms, so that it is difficult to know whether we should place it with *Tubulipora* or *Defrancia*.

*Habitat*.—Washings from dredge between Fayal and Pico, 50 to 90 fathoms. Fossil—Coralline Crag.

*Lichenopora holdsworthii*, Busk, occurs from Station 142, 150 fathoms, on *Adeonella regularis*.

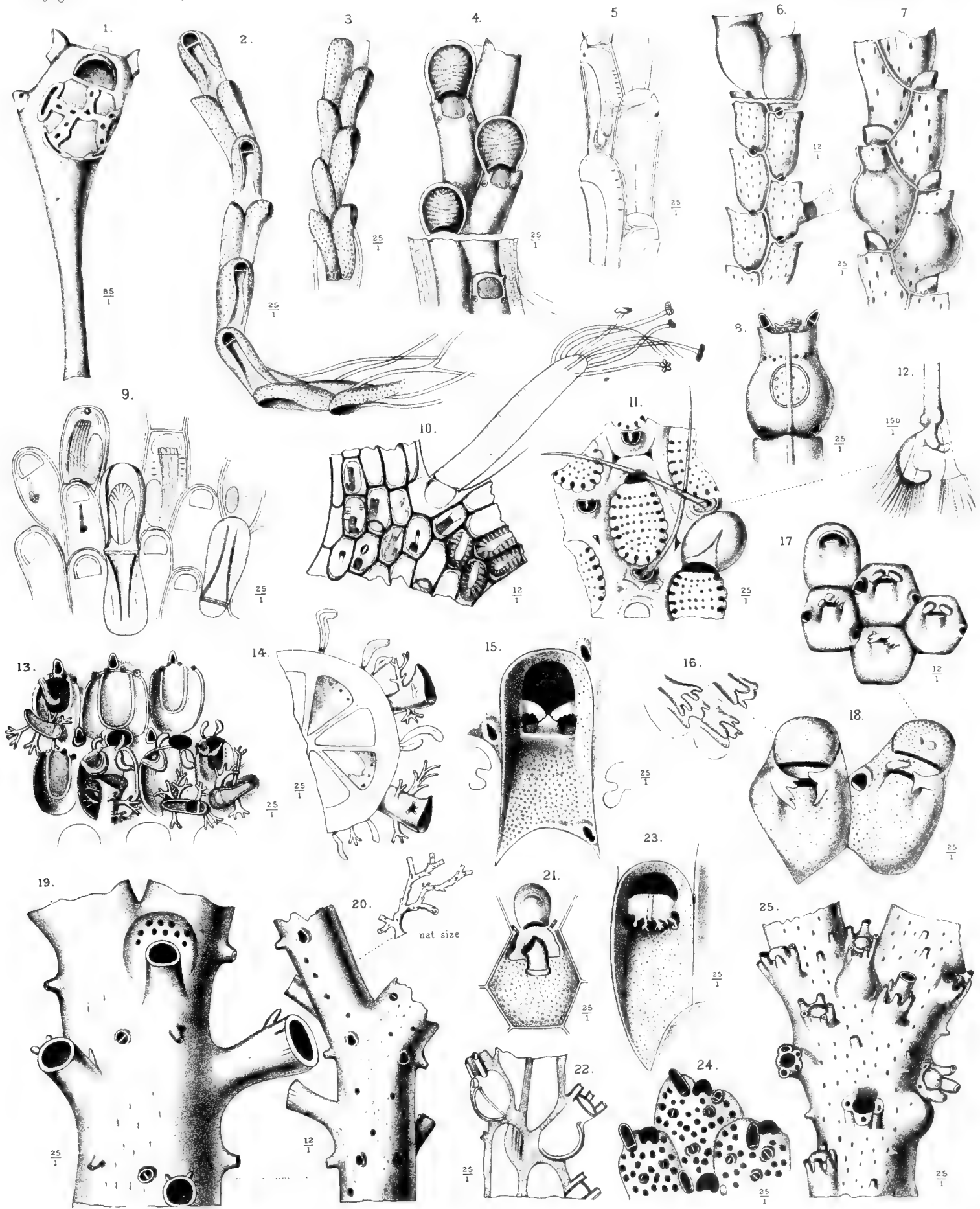
*Idmonea atlantica*, Forbes, add Station 49, 85 fathoms.

# PLATE I.

	Diam.
Fig. 1. <i>Catenaria bicornis</i> , Busk, . . . . .	× 85
Fig. 2, 3. <i>Farriminaria biseriata</i> , n. sp., . . . . .	× 25
Fig. 4. <i>Ichthyaria oculata</i> , Busk ; the lower part shows the lateral chitinous growth, . . . . .	× 25
Fig. 5. Section of <i>Calwellia sinclairii</i> , Busk ; showing the membrane dividing the zoëcia, . . . . .	× 25
Fig. 6. <i>Bifaxaria submucronata</i> , Busk ; the lower part is calcined, the upper part showing the ovicells is not, . . . . .	× 12
Fig. 7. <i>Bifaxaria corrugata</i> , Busk ; showing the ovicells and avicularia as seen laterally, . . . . .	× 25
Fig. 8. <i>Bifaxaria corrugata</i> , Busk ; ovicell from the front, . . . . .	× 25
Fig. 9. <i>Flustra separata</i> , n. sp. ; the left hand avicularium is shown open, the right closed, . . . . .	× 25
Fig. 10. <i>Flustra cribriformis</i> , Busk ; showing the radical attachment, and from the cells on the right the upper wall has been removed to show the basal wall, . . . . .	× 12
Fig. 11. <i>Cribrilina latimarginata</i> , Busk, . . . . .	× 25
Fig. 12. <i>Cribrilina latimarginata</i> , Busk ; base of vibraculum, . . . . .	× 150
Fig. 13. <i>Electra cylindracea</i> , Busk, . . . . .	× 25
Fig. 14. <i>Electra cylindracea</i> , Busk ; transverse section, . . . . .	× 25
Fig. 15. <i>Thalamoporella steganoporoides</i> , Goldstein ; calcined, . . . . .	× 25
Fig. 16. <i>Aspidostoma gigantea</i> , Busk ; cervicorne processes seen from the side.	
Fig. 17. <i>Aspidostoma gigantea</i> , Busk, . . . . .	× 12
Fig. 18. <i>Aspidostoma gigantea</i> , Busk, . . . . .	× 25
Fig. 19. <i>Porina proboscidea</i> , n. sp. ; anterior surface, . . . . .	× 25
Fig. 20. <i>Porina proboscidea</i> , n. sp. ; dorsal surface, . . . . .	× 12
Fig. 21. <i>Membranipora umbonata</i> , Busk, var., . . . . .	× 25
Fig. 22. Section of <i>Turritigera stellata</i> , Busk ; showing the ovicells, . . . . .	× 25
Fig. 23. <i>Thalamoporella labiata</i> , Busk ; calcined, . . . . .	× 25
Fig. 24. <i>Mucronella contorta</i> , Busk, . . . . .	× 25
Fig. 25. <i>Turritigera stellata</i> , Busk, . . . . .	× 25

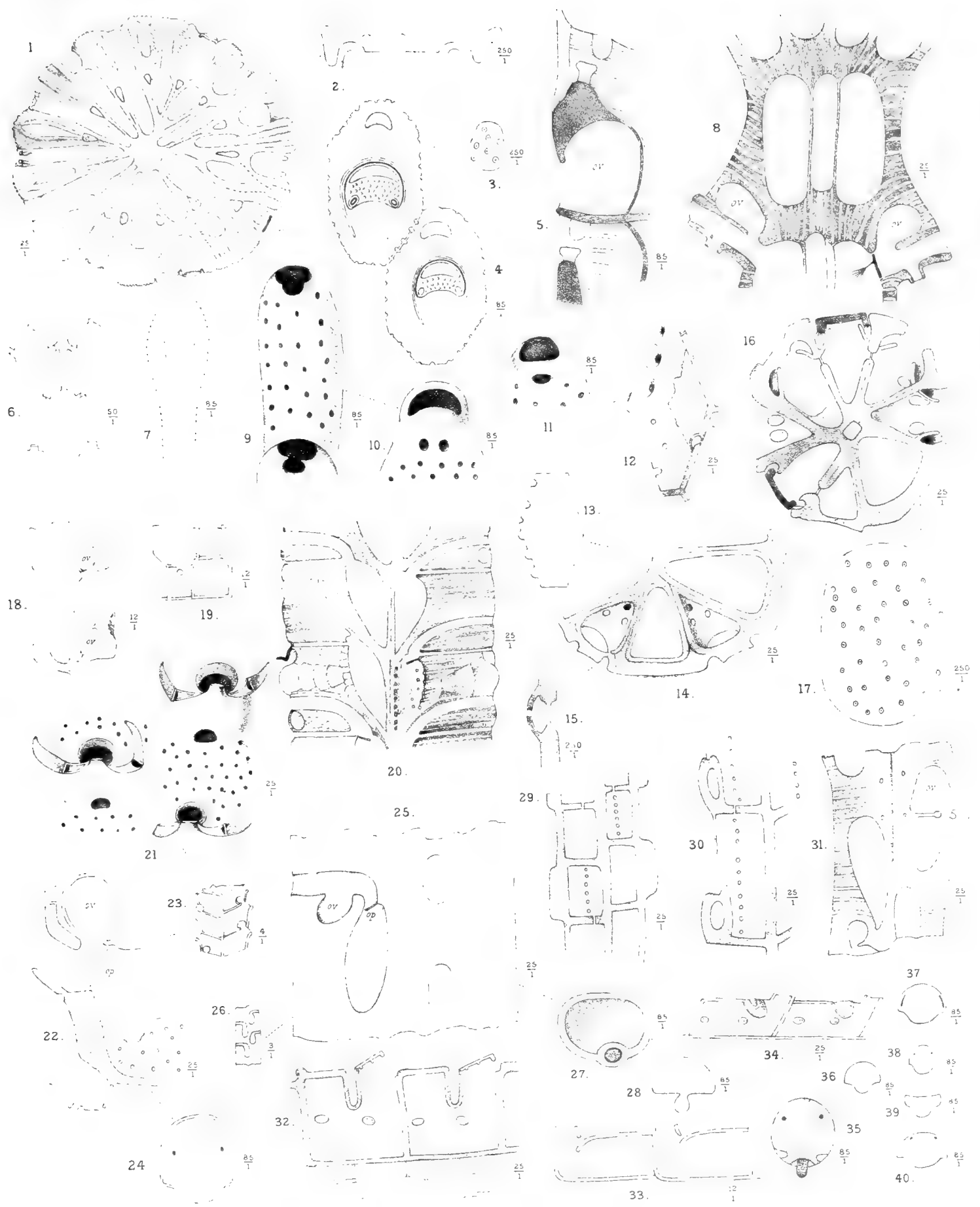
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# PLATE II.

	Diam.
Fig. 1. Transverse section of <i>Cellaria australis</i> , MacGillivray; showing the opercula <i>in situ</i> , and also the distal rosette plates, . . . . .	× 25
Fig. 2. <i>Cellaria australis</i> , MacGillivray; section of operculum as seen in fig. 1, showing the denticles in the sockets, . . . . .	× 250
Fig. 3. <i>Cellaria australis</i> , MacGillivray; distal rosette plates, . . . . .	× 250
Fig. 4. <i>Cellaria australis</i> , MacGillivray; outer membranous layer decalcified, showing operculum and ovicellular cover <i>in situ</i> , . . . . .	× 85
Fig. 5. <i>Cellaria rigida</i> , MacGillivray; section showing the denticles, an ovicell, and the pore tubes, . . . . .	× 85
Fig. 6. <i>Cellaria rigida</i> , MacGillivray; longitudinal calcareous section at a lower level than fig. 7, . . . . .	× 50
Fig. 7. <i>Cellaria rigida</i> , MacGillivray; longitudinal calcareous section cut near the surface showing the pores, . . . . .	× 85
Fig. 8. <i>Porina coronata</i> , Reuss (sent as <i>Myriozonium australiense</i> by Haswell from Holborn Island); section showing the ovicells, . . . . .	× 25
Fig. 9. <i>Adeonella polymorpha</i> , Busk; young cells, the lower one showing the commencement of the bridge, . . . . .	× 85
Fig. 10. <i>Adeonella polymorpha</i> , Busk; ovicelligerous cell with double pore, . . . . .	× 85
Fig. 11. <i>Adeonella polymorpha</i> , Busk; with bridge forming a peristomial pore, . . . . .	× 85
Fig. 12. <i>Thalamoporella labiata</i> , Busk; calcareous section diagonally through a zoecium, thus showing the projecting rosette plates, . . . . .	× 25
Fig. 13. <i>Thalamoporella labiata</i> , Busk; diagrammatical section showing the position of the rosette plates, . . . . .	
Fig. 14. <i>Thalamoporella labiata</i> , Busk; transverse section, . . . . .	× 25
Fig. 15. <i>Thalamoporella labiata</i> , Busk; section through the rosette plate, . . . . .	× 250
Fig. 16. <i>Monoporella capense</i> , Busk; showing lamina for the muscular attachments and also distal rosette plates, . . . . .	× 25
Fig. 17. <i>Monoporella capense</i> , Busk; distal rosette plate, . . . . .	× 250
Fig. 18. <i>Melicerita atlantica</i> , Busk; longitudinal section showing the position of the ovicell, . . . . .	× 12
Fig. 19. <i>Melicerita dubia</i> , Busk; diagrammatic transverse section, . . . . .	× 12
Fig. 20. <i>Adeonella atlantica</i> , Busk; longitudinal section showing the position of the peristomial pore, . . . . .	× 25
Fig. 21. <i>Schizoporella polymorpha</i> , Busk, . . . . .	× 25
Fig. 22. <i>Schizoporella polymorpha</i> , Busk; section showing the peristomial aperture, with the operculum <i>in situ</i> , and also an ovicell in section, . . . . .	× 25
Fig. 23. <i>Schizoporella polymorpha</i> , Busk; diagrammatic longitudinal section, . . . . .	× 4
Fig. 24. <i>Schizoporella polymorpha</i> , Busk; operculum, . . . . .	× 85
Fig. 25. <i>Schizoporella challengerii</i> , n. n.; showing the position of the operculum and a cavity below the peristome (probably an ovicell), . . . . .	× 25
Fig. 26. <i>Schizoporella challengerii</i> , n. n.; diagrammatic section of zoarium, . . . . .	× 3
Fig. 27. <i>Schizoporella challengerii</i> , n. n.; section through the peristomial aperture, showing the tube leading to the avicularium, . . . . .	× 85
Fig. 28. <i>Schizoporella challengerii</i> , n. n.; operculum, . . . . .	× 85
Fig. 29. <i>Membranipora tubigera</i> , Busk; transverse section, . . . . .	× 25
Fig. 30. <i>Membranipora tubigera</i> , Busk; longitudinal section showing avicularian chamber and rosette plates, . . . . .	× 25
Fig. 31. <i>Bifuscaria denticulata</i> , Busk; longitudinal section showing the ovicell above the oral aperture, . . . . .	× 25
Fig. 32. <i>Steganoporella neozelanica</i> , Busk; longitudinal section, . . . . .	× 25
Fig. 33. <i>Thalamoporella labiata</i> , Busk; longitudinal section, . . . . .	× 12
Fig. 34. <i>Micropora impressa</i> , Moll; longitudinal section, from Naples, . . . . .	× 25
Fig. 35. <i>Adeonella</i> (?) <i>regularis</i> , Busk; operculum, . . . . .	× 85
Fig. 36. <i>Adeonella polystomella</i> , Reuss; operculum, . . . . .	× 85
Fig. 37. <i>Adeonella atlantica</i> , Busk; operculum, . . . . .	× 85
Fig. 38. <i>Adeonella platulea</i> , Busk; operculum, . . . . .	× 85
Fig. 39. <i>Adeonella intricaria</i> , Busk; operculum, . . . . .	× 85
Fig. 40. <i>Adeonella polymorpha</i> , Busk; operculum, . . . . .	× 85



# PLATE III.

	Diam.
Fig. 1. <i>Cellepora pustulata</i> , Busk, . . . . .	× 25
Fig. 2. <i>Cupularia canariensis</i> , Busk, . . . . .	× 50
Fig. 3. <i>Selenaria maculata</i> , Busk, . . . . .	× 85
Fig. 4. <i>Cellepora armata</i> , Hincks, var. <i>erecta</i> , nov., . . . . .	× 25
Fig. 5. <i>Retepora magellensis</i> , Busk, . . . . .	× 25
Fig. 6. <i>Retepora gigantea</i> , Busk, . . . . .	× 25
Fig. 7. <i>Retepora tessellata</i> , Hincks, var. <i>imperati</i> , Busk; section of rooting process, . . . . .	× 12
Fig. 8. <i>Retepora tessellata</i> , Hincks, var. <i>imperati</i> , Busk; rooting process, . . . . .	× 25
Fig. 9. <i>Retepora lata</i> , Busk; section of calcareous structure, showing lacunæ on the right, . . . . .	× 25
Fig. 10. <i>Retepora columnifera</i> , Busk; section showing zoarial parenchym cord, . . . . .	× 85
Fig. 10a. <i>Retepora columnifera</i> , Busk; section showing zoarial parenchym cord, . . . . .	× 250
Fig. 11. <i>Retepora columnifera</i> , Busk; ovicell calcined, . . . . .	× 85
Fig. 12. <i>Retepora cellulosa</i> , L., Naples; showing gland-like sacs at the side, . . . . .	× 85
Fig. 13. <i>Retepora cellulosa</i> , L., Naples; double sac, . . . . .	× 250
Fig. 14. <i>Cellepora pertusa</i> , Smitt, Red Sea; showing vermiform gland-like bodies, . . . . .	× 85
Fig. 15. <i>Lepralia margaritifera</i> , Quoy and Gaimard; contents of avicularian chamber, showing double gland-like bodies and the protoplasmic mass, . . . . .	× 250
Fig. 15a. <i>Lepralia margaritifera</i> , Quoy and Gaimard; section of the larger body, . . . . .	× 250
Fig. 16. <i>Lepralia margaritifera</i> , Quoy and Gaimard, . . . . .	× 25
Fig. 17. <i>Selenaria maculata</i> , Busk; lower part of vibraculum, . . . . .	× 250
Fig. 18. <i>Bifazaria submucronata</i> , Busk; operculum, . . . . .	× 85
Fig. 19. <i>Foveolaria elliptica</i> , Busk; operculum, . . . . .	× 85
Fig. 20. <i>Aspidostoma gigantea</i> , Busk; avicularian mandible, . . . . .	× 85
Fig. 21. <i>Aspidostoma gigantea</i> , Busk; operculum, . . . . .	× 85
Fig. 22. <i>Melicrita atlantica</i> , Busk; operculum, . . . . .	× 85
Fig. 23. <i>Electra cylindracea</i> , Busk; mandible, . . . . .	× 85
Fig. 24. <i>Melicrita dubia</i> , Busk; operculum, . . . . .	× 85
Fig. 25. <i>Monoporella capensis</i> , Busk; operculum, . . . . .	× 85
Fig. 26. <i>Smittia delicatula</i> , Busk, . . . . .	× 25
Fig. 27. <i>Cupularia canariensis</i> , Busk; base of vibraculum, . . . . .	× 250
Fig. 28. <i>Diporula hastigera</i> , Busk; mandible, . . . . .	× 85
Fig. 29. <i>Diporula hastigera</i> , Busk; operculum, . . . . .	× 85
Fig. 30. <i>Lepralia mucronata</i> , Busk; operculum, . . . . .	× 85
Fig. 31. <i>Schizoporella vitrea</i> , MacGillivray; operculum, . . . . .	× 85
Fig. 32. <i>Lepralia oclusa</i> , Busk; operculum, . . . . .	× 85
Fig. 33. <i>Lepralia oclusa</i> , Busk; mandibles, . . . . .	× 85
Fig. 34. <i>Lepralia oclusa</i> , Busk, . . . . .	× 25
Fig. 35. <i>Melicrita dubia</i> , Busk; reduced from sketch, . . . . .	× 6
Fig. 36. <i>Lepralia castanea</i> , Busk; operculum, . . . . .	× 85
Fig. 37. <i>Lepralia castanea</i> , Busk; mandible, . . . . .	× 85
Fig. 38. <i>Hasicellia auriculata</i> , Busk; operculum, . . . . .	× 85
Fig. 39. <i>Retepora tessellata</i> , Hincks, var. <i>imperati</i> , Busk; operculum, . . . . .	× 85
Fig. 40. <i>Retepora lata</i> , Busk; operculum, . . . . .	× 85
Fig. 41. <i>Cellepora armata</i> , Hincks, var. <i>erecta</i> , nov., operculum, . . . . .	× 85
Fig. 42. <i>Cellepora armata</i> , Hincks, var. <i>erecta</i> , nov., mandibles, . . . . .	× 85
Fig. 43. <i>Cellepora armata</i> , Hincks, var. <i>erecta</i> , nov., mandibles, . . . . .	× 85
Fig. 44. <i>Mucronella canalifera</i> , Busk; operculum, . . . . .	× 85
Fig. 45. <i>Defrancia striatula</i> , Busk, . . . . .	× 6
Fig. 46. <i>Schizoporella vitrea</i> , MacGillivray, . . . . .	× 25
Fig. 47. From Station 320 (see page 39), . . . . .	× 12

